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REBUILT BATCH PLANT AT THATCHER MANUFACTURING COMPANY INCORPORATES AUTOMATIC WEIGHING

At its Elmira plant the Thatcher Manufacturing Co. is now operating a batch preparation system which includes such new equipment as automatic weighing devices, a new mixer and mixed batch distribution in buckets on a tramrail.

The problem of accurate batch proportioning on a commercial scale, which now faces so many glass production units, was under consideration by the executives and engineers of the Thatcher Manufacturing Co. in its Elmira plant for several years. The situation here was complicated, as it is in many factories, by the fact that a complete batch system was already in existence and, therefore, any new equipment would have to be fitted into the existing structures, as far as possible, without interfering with regular production schedules. However, the desirability of accurately proportioned batch for the high quality of glass required for milk bottles, the possible prevention of segregation in the batch between mixer and tank, and the elimination of the dust hazard in the batch preparation operations, all combined to keep the proposition alive in spite of early failures to find a reasonable solution to the problem.

Modern developments in batching methods during the last few years made it immediately possible to outline broadly the practicable means for accomplishing the desired results, including automatic weighing and collecting, adequate mixing, and distribution of mixed batch to the furnaces in unit containers with a minimum of agitation in transit. A suitable plan for installing the weighing and mixing equipment in the existing batch plant during regular operation proved to be the most difficult obstacle and many schemes were suggested and discarded before a workable program was finally reached. The new equipment was installed and made ready for the change-over while the old plant was in operation and the final shift from old to new equipment was accomplished by adding a couple of days to a regular weekend shutdown. The fine results obtained in the new plant and the small amount of productive time lost are very creditable to the Thatcher organization and the suppliers of the new equipment. The plant has now been in operation since the first of this year.

Raw materials are stored in the eight circular bins of the original plant, each bin being 24 ft. in diameter by 26 ft. high and having capacity for about 600 tons of sand, but from this point on all of the old equipment was replaced. Beneath the bins in the basement of the house runs a long gallery or tunnel, this gallery being only about 8 ft. high and 8 ft. wide. The old bin gates were replaced by new bin openings which lead directly into the feeders of the automatic weighing system. From south to north, that is, from left to right as you face the batch house from the factory proper, the contents of the

Fig. 1. In the rebuilt Thatcher batch plant the automatic weighing equipment was installed in an existing gallery beneath the storage bins. Here are seen one of the automatic scales with its weigh hopper and one of the electrical vibrating feeders in the background. One of the two collecting conveyors is located in the steel housing on the floor.

Fig. 2. This close-up shows the hopper-unloading feeder which handles cullet. The weigh hopper appears at the left and the feeder discharges into the conveyor through the covered opening in the foreground.

Fig. 3. Vibrating feeders and weigh hoppers are supported on steel framework in the gallery. Here the hopper-loading feeder takes material from the bin above and discharges into the hopper, another feeder taking the weighed material from the conical weigh-hopper and discharging into the conveyor.

Fig. 4. This view shows the drives of the two collecting conveyors which discharge into a common chute leading to the elevator which rises at the left.

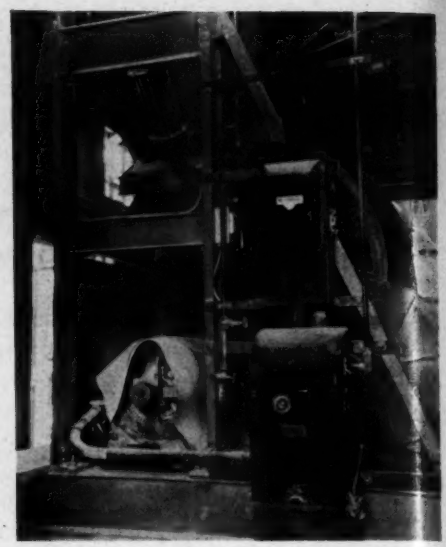


Fig. 5. The bottom of the surge bin can be seen in the foreground above the mixer. The air cylinder that operates the bin gate valve can be seen close to the sloping bottom of the bin.

bins are as follows: (1) sand, (2) sand, (3) soda ash, (4) feldspar, (5) cullet, (6) lime, (7) soda ash, (8) sand. Only five of the bins deliver materials at any one time, the extra sand and soda ash bins providing additional storage capacity. All eight bins are provided with feeders and scales and any one of the extra storage bins can be connected into the system at any time by simply flipping a switch on the central control panel.

Weighing and Collecting of Materials

The packing of the scales, feeders, hoppers and collecting conveyors into the small gallery below the storage bins presented a difficult design problem, but a satisfactory arrangement was finally secured by hanging the weigh hoppers and feeders from a steel framework instead of from the ceiling of the gallery. This framework appears in Figs. 1 and 3, these views also showing the typical arrangement of feeders, hopper and scales beneath each bin. The installation includes Toledo scales and Jeffrey-Traylor vibration-type feeders. The design of the entire weighing, collecting and mixing system and its controls was worked out by engineers of the Toledo Scale Co. in cooperation with Thatcher executives.

The type of Jeffrey-Traylor feeder used in this installation is shown in Fig. 2, this feeder taking cullet from the weigh hopper at the left and delivering it to the collector belt through the covered opening in the conveyor housing in the right foreground. The feeder passage proper is in the horizontal section close to the conveyor housing, the slanting portion being the electrical vibrator and its frame connection. Beneath each bin, and close up to the ceiling of the gallery, a similar feeder takes material from the bin opening and delivers it to the weigh hopper, the only difference being that these hopper-loading feeders may be said to be bottom side up with the electrical vibrator portion slanting downward, as shown in Fig. 3.

The weigh hoppers hang in scale mechanisms attached to the steel framework, the weighing impulse being transmitted to the scales by long levers and pull rods, one of which appears in the foreground in Fig. 1. The scales are of the familiar Toledo dial type with electrical controls for feeders and interlocks located in the bases. Scale capacities for the various bins are as follows: Sand—2,500 lb.; Soda ash—1,000 lb.; Lime—500 lb.; Cullet—2,000 lb.; Feldspar—500 pounds.

Each of the two horizontal collecting conveyors serves four material bins and at the center of the building discharge into a common chute which leads into the bottom of an elevator housing. In turn, the elevator discharges into a bin or surge tank located just above the charging end of the mixer. The discharge ends of the collecting conveyors with the driving motors and gearing are shown in Fig. 4 and the light-colored housing of the elevator can be seen rising at the left. Also appearing in this view is the electrical vibrator for the feldspar hopper-discharge feeder. The horizontal conveyors have 24-in. rubber-faced belts running at about 150 ft. per min., the north and south belts being on 87- and 83-ft. centers, respectively. The elevator is 43 ft. high and of the cupped-belt style.

The surge bin, in which the batch materials are collected before mixing, is located in such a position that its top projects into the room where the central control panel is located. Minor ingredients, such as salt cake and decolorizer, are weighed out into small containers and dumped into the surge bin by hand just before the main ingredients are discharged into the bin from the elevator. Tentative plans for the automatic weighing and feeding of the minor ingredients have been made and the necessary equipment will probably be installed in the future. The discharge gate of the surge bin is operated by a Hanna air cylinder, the action of the cylinder being controlled by a solenoid valve that is actuated by interlocks and limit switches from other points, as

will be explained later. In Fig. 5 the lower portion of the surge bin with the discharge gate cylinder can be seen.

The mixer, the driving end of which is shown in Fig. 5 and a side view in Fig. 6, was furnished by the Ransome Concrete Machinery Co. and has a designated capacity of 75 cu. ft. The mixer speed is 10.4 r.pm. The mixing operation is automatically timed so that an interval of at least 3½ minutes must elapse after the opening of the surge bin gate before the unloading mechanism can be operated to discharge the mixer contents. Another interlock is also interposed in the discharge mechanism so that the mixer cannot be dumped unless there is a batch bucket in position to receive the charge. In Fig. 6 the bottom of the surge bin appears at the upper left with gate arm and air cylinder and the unloading chute is at the right

Fig. 7 shows an empty batch bucket in position for loading at the mixer. The bucket hangs from a short section of tramrail which is, in turn, attached to the framework of a skip-type hoist, the hoist running on inclined parallel rails which lead to the main tramrail system on an upper level. The vertical lift of the hoist is 25 ft., with a lifting speed of 40 ft. per min. The bucket has a hinged top and, as the hoist nears the bottom of its travel, this top is automatically raised and an automatic folding chute makes a dust-tight connection between the mixer and the bucket. With the bucket in this position the discharge of the mixer can be started and the discharge interval is automatically timed at 30 seconds. At the end of the 30-sec. interval the mixer discharge shovel automatically moves "out" and the loaded bucket is carried upward on the hoist.

At the top of the hoist travel the short section of tramrail fits into an opening in the main tramrail, the loaded bucket is pushed off the hoist, an empty bucket is pushed on, and the hoist again descends to the loading position at the mixer. All of these operations are automatic. The complete mixed-batch distribution system, including tramrail, buckets, pushers, tractor, hoist, etc., was furnished by the Cleveland Tramrail Division of the Cleveland Crane & Engineering Co.

Batch Preparation Cycle and Control

Before going into the further details of the tramrail system, it is well to look at the batch preparation cycle and its control, since the whole line of equipment from the weigh-hopper loading feeders to the batch bucket hoist is tied together in such a way that the different batching operations automatically follow each other in proper order and timing. The control for the system centers in a panel located on the floor above the mixer and from this point the operator supervises the entire process. From the view in Fig. 9 it will be noted that the control panel carries three horizontal rows of signal lights at the top, and push-button controls of the "start-stop" type. Four or five additional push-button switches have been added to the panel since this picture was made, these additional buttons controlling the conveyor and elevator motors and the starting of the mixer discharge.

From the foregoing description of the weighing and mixing equipment, it is apparent that a complete batch can be collected and held at three points in the system—

Fig. 7. The empty batch bucket has been lowered to loading position at the mixer by means of a Cleveland Tramrail skip-type hoist.

Fig. 8. In this view the loaded bucket approaches the end of its 25-ft. lift, where it will be automatically transferred to the tramrail leading to the furnaces. The hoist will then automatically receive an empty bucket and descend to the loading position at the mixer.

Fig. 6. In this side view of the Ransome mixer the bottom of the surge bin again appears, at the upper left, with the mixer discharge boot at the extreme right.

Fig. 9. At the top of the central control panel are signal lights which indicate the working of the automatic weighing system. The panel also carries push buttons for controlling the various operations of weighing, mixing and hoisting.

in the weigh hoppers, in the surge bin, and in the mixer. In order to follow through the process with the least difficulty, it may be assumed that there is a batch at each of these points, that there is a supply of empty batch buckets on the tramrail near the hoist, and that none of the machinery motors nor feeder solenoids are energized. The hoist motor switch is closed first, whereupon an empty bucket is automatically pushed upon the hoist and lowered to loading position at the mixer, thus releasing the interlock which permits dumping of the batch already mixed and held in the mixer.

The mixer motor is now started. Then, in order, the motors for elevator and conveyors are started by push-buttons at the control panel and operation of another button energizes the feeder solenoids. The system is now ready to function and the cycle is started by pushing another button which controls the "in" movement of the mixer unloader and causes the mixer load to be delivered into the empty batch bucket. At the end of a 30-sec. interval, the unloader moves "out" and trips a limit switch which starts the hoist upward with the loaded bucket and also energizes the solenoid valve which admits air to the bin gate cylinder, opening the gate and permitting the batch held in the surge bin to pass into the mixer. This gate also remains open for an interval of 30 seconds and then closes, actuating, as it reaches the closed position, a limit switch which starts the weigh-hopper unloading feeders. Meanwhile, the batch bucket hoist has reached its upper level where the loaded bucket has been pushed off upon the tramrail. As the loaded bucket moves off, an empty bucket has been pushed upon the hoist and then carried down to the loading position where it remains in readiness to receive the material now being processed in the mixer.

While the mixing is going on, let us turn our attention to the control panel and the three horizontal rows of signal lights already mentioned. It will be noted that there are eight lights in each row, corresponding to the eight raw material bins, the rows being marked, from top to bottom, "Discharge," "Weigh" and "Hold," respectively. When the feeder solenoids are first energized, before the cycle begins, five yellow lights appear in the lower row, these lights corresponding in position to the five weighing mechanisms in use at any one time and indicating that the weigh hoppers are holding materials for a complete batch in readiness to discharge to the collecting conveyors. As soon as the surge bin gate closes, however, the lights in the lower row go out and five yellow lights start to glow in the top row, thus indicating that the unloading feeders have started to discharge materials from the hoppers upon the collecting belts. This action is confirmed in a few seconds when the material can be heard passing down through the chute from the top of the elevator to the surge bin.

Further action of the weighing units can be observed to advantage in the weigh gallery, where the unloading feeders are now emptying the weigh hoppers and the pointers on the scales are moving toward the zero point. As soon as the zero position on any one scale is reached, limit switches and relays in the scale mechanism cause the unloading feeder to stop and immediately start the loading feeder delivering material from the storage bin to the weigh hopper. The scale pointer rises rapidly during the first part of the hopper filling operation, but the filling rate is automatically reduced as the desired weight is neared; the pointer then approaches slowly and finally comes to rest directly on the exact weight, as the feeder automatically stops. On the control panel, the yellow light in the top row corresponding to this unit went out as the hopper-loading feeder started and a red light appeared in the middle row, indicating that the weighing operation was in progress. As soon as the proper amount of material is in the hopper, the red light goes out and a yellow light appears again in the lower row to indicate that weighing has been completed and that the material is being "held." In this manner all of the weighing units go through their automatic cycles, until the original row of yellow lighs in the bottom row indicates that another batch is ready for discharge to the surge bin. None of the hoppers can be

Fig. 11. Looking from the tramrail gallery leading to the furnace room, the top of the bucket skip-hoist and the automatic reciprocating pusher, alongside the main tramrail, can be seen.

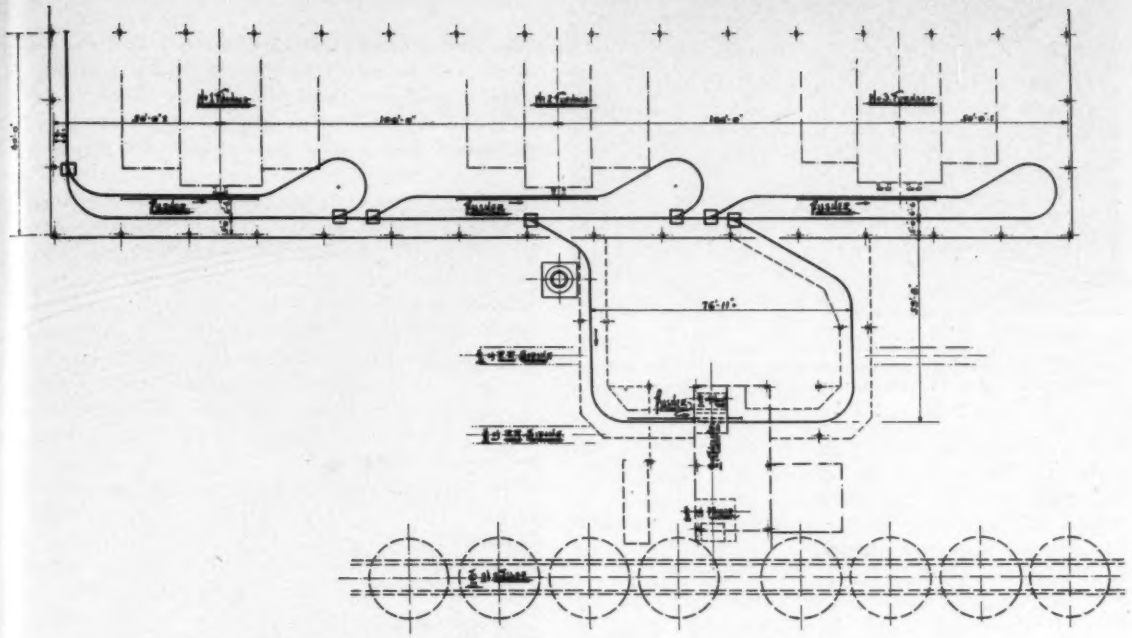


Fig. 10. The location of the tramrail system in relation to the furnaces and the raw material storage bins is shown by this diagram. The open squares indicate the manually-operated switches and the locations of the four reciprocating pushers are also shown.

discharged until all have been filled with the proper amount of material.

Mixed Batch Distribution

The general arrangement of the tramrail system for distributing mixed batch to the three furnaces is shown in the diagram in Fig. 10. It will be noted that the main tramrail line extends down the entire length of the furnace room with side tracks at each furnace. Each side-track consists of a straight section passing over the batch hopper above the doghouse, followed by a loop that reenters the main track beyond the furnace position. Directly back of No. 2 furnace another switch turns off to the right, and curves through an enclosed gallery to the hoist position. Beyond the hoist the tramrail curves back through another gallery and switches into the main line near the rear of No. 3 furnace. The tramrail system is supported on heavy steel framework designed and installed by the American Bridge Co.

Another view of the tramrail arrangement at the top of the skip hoist is shown in Fig. 11, this picture being taken from the gallery through which the loaded buckets pass to the furnace room and looking into the gallery through which the empty buckets approach the hoist. Alongside the main tramrail can be seen the automatic reciprocating pusher mechanism which removes the loaded bucket from the hoist and puts an empty bucket in place. The pusher consists of a couple of motor-driven sheaves mounted on a section of 8-in. arch-beam, the sheaves carrying a length of steel cable. Attached to the cable are pawls which make contact with the batch buckets on the tramrail. Limit switches control the automatic operation of the pusher.

From the hoist the loaded buckets roll into the gallery and remain until taken out into the furnace room. There are 35 of these buckets, each having a diameter of 52 in. and a capacity of 62 cu. ft., equivalent to about 4,750 lb. of batch. Actually a complete batch, as proportioned at present, weighs slightly over 4,000 pounds. The buckets are mounted on special 4-wheel carriers with bumpers and couplings at both ends. On the bottom of each bucket is a swinging gate fitted with rollers which engage stationary cams at the furnace positions and open the gate automatically.

The loaded buckets are pulled out of the hoist gallery by an electric tractor and switched into the proper side-track for any desired furnace. Fig. 12 shows the tractor

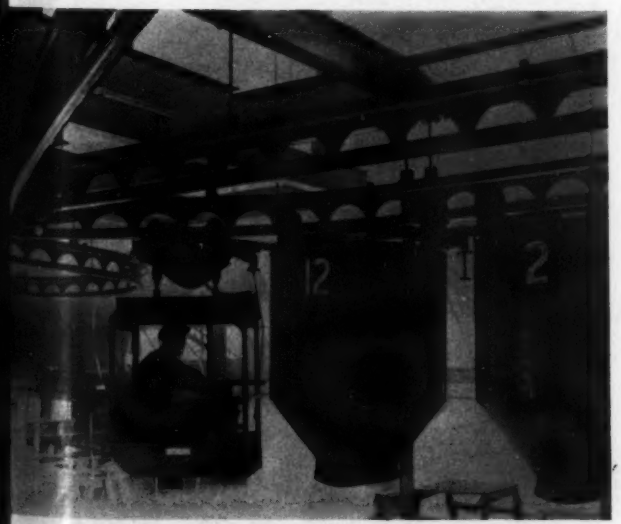


Fig. 12. Loaded batch buckets are here being pushed into the side-track above No. 2 furnace. The cab-type tractor has a maximum speed of 175 ft. per min. and variable-speed control.

Fig. 13. As the loaded batch bucket approaches a position over the furnace hopper the swinging gate in the bottom of the bucket is automatically opened by a stationary cam.

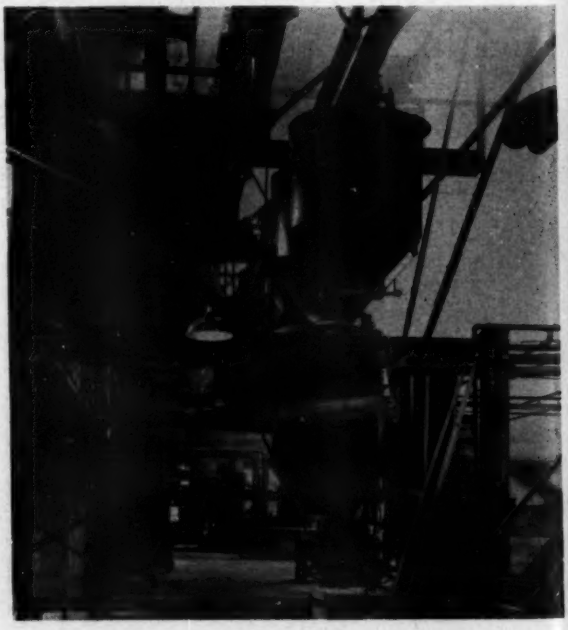
as it pushes loaded buckets into position at No. 2 furnace. The tractor is of the open-cab type with bumper and coupling at the front end and a variable-speed controller. The maximum tractor speed is 175 ft. per min. Switches are manually operated by chains which hang down at convenient locations and are operated from the cab. A couple of these switch chains can be seen in Fig. 13, which also shows the batch passing from the tramrail bucket into the hopper above the doghouse of No. 2 tank. This view indicates the operation of the swinging gate at the bottom of the bucket and shows the stationary cam which causes it to open as the bucket comes into position over the hopper. Immediately above the buckets can be seen the cable and pawls of another reciprocating pusher, similar to the one previously described at the hoist position. One of these pushers is installed at each furnace and is operated by push button from the furnace floor.

Fig. 14 is another view of the loaded batch buckets at No. 2 furnace, taken from the furnace room floor. The main tramrail line appears at the upper right, together with the switch by which the empty buckets enter the gallery leading to the mixing building hoist. The tramrail system provides enough storage capacity for mixed batch so that the batch plant operates only on two seven-hour shifts in 24 hours. On each shift one man handles all of the batching operations and the distribution of the batch to the furnaces. Another view of the batch buckets at No. 2 tank appears in Fig. 15, taken from the opposite direction to Fig. 14. Here the first bucket in the line has been emptied and is entering the loop on which empty buckets are stored, one end of the reciprocating pusher appearing above the buckets. The main tramrail line appears at the upper left, together with one of the switches leading into the hoist gallery.

The rebuilt Thatcher batch plant is of particular interest because it is one of the first existing plants to be equipped with automatic weighing and mixing apparatus. An important feature is the fact the weighing equipment is flexible enough to permit installation in the rather restricted spaces available without major changes in the batch building structure. Formerly the mixed batch was transported to the furnace building in an electrical driven batch car on an elevated track and discharged direct into large storage bins above each doghouse. The system easily overcomes the obstacles of difference in level between weighers and mixers and furnaces, as well as the location of the batch house at a considerable distance from the furnace room. As this article is written the plant has prepared several thousand batches without trouble and the accuracy of proportioning is already apparent in the better quality of glass produced. Batching costs with the new system appear very reasonable and segregation and dusting have practically disappeared.

Fig. 14. This view in the furnace room shows a line of loaded buckets above No. 2 furnace. The main tramrail and the switch leading to the hoist appear at the upper right.

Fig. 15. Another view of the batch buckets above No. 2 tank shows an empty bucket passing into the storage loop. Here the furnace hopper and the chute leading to the doghouse are clearly shown.



COLORED SILVERING OF GLASS

By DR. BRUNO SCHWEIG

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Colored mirrors are produced by two fundamentally different methods. The first method takes colored glass and coats it with silver in the usual way, and since glass can be made in practically all tints of the spectrum, mirrors can be made and are being made in the widest possible variety of colored glass. Because the method is very simple, it is the one most generally employed.

The second method makes use of ordinary crystal glass —polished plate or sheet, on which is deposited a layer of tinted metal or metallic compound. It is with this latter method that we shall deal in the present discussion.

A definite demand exists for the type of mirror whose color is derived from the coating. In some tints or shades, it is the cheaper glass; or, again, the special tone required may be impossible to secure except through the medium of a reflecting metal. Then there are special problems; as, for example, those encountered in the manufacture of advertising displays, where one can secure a certain result only by removing a portion of the reflective coating and applying in that place a color which will not be affected by the color of the glass itself. Still another situation might be the manufacture of a mirror in several colors, all on the same plate.

We have said that metals or metal compounds are used in the manufacture of this particular type of colored mirror. These are necessary, because so far there is no other material available which will reflect so well and evenly as is necessary for a perfect image. Of the metals, only gold and copper have a color distinct from silver. Of the metal compounds, one that is useful for mirrors is lead sulphide, which yields a gray-blue or dull gray, pewter-like reflection. Nearly everybody has seen these gray-blue mirrors; perhaps as decorations, with some kind of embossing, perhaps as rear-view mirrors in automobiles, where their non-glare properties are available in shielding the eyes from dazzle. A very modern use is for cathode tubes in television.

The gray-blue process was invented by Messrs. O. Hauser and E. Biesalski in 1910. They had found that some metals in an alkaline solution can be deposited as sulphides by thiocarbamide and that a few metal sulphides settle as a mirror on glass. The best result is obtained with lead sulphide. Other inventors and investigators have improved upon and perfected the process. To mention a few: James Emerson Reynolds and George Rud. Grubb, German Patent 144582 and 148893; Dr. Joh. Heidenhain, G. P. 486392 and 534579; George F. and William H. Colbert, American P. 1603936, 1662564 and 1662565; William Peacock, Jr., A. P. 1988633; Joseph Karfunkel, secret formula; Stanley Thomas Henderson, English Patent 464105; and the author of this article.

The basis for the various processes is always the same: An aqueous solution of lead nitrate or lead acetate or sometimes lead tartrate is mixed with a solution of thiocarbamide (sulph-urea) and a solution of sodium hydroxide (Caustic Soda) or potassium hydroxide (Caustic Potash) is added. The formulas differ only with regard to the strength of the solutions employed. The following table shows as an illustration the concentrations for four different formulas:

SOLUTIONS FOR LEAD SULPHIDE PROCESS

Material	Concentration in %			
	I	II	III	IV
1. Lead Nitrate or Acetate	.5	2.0	4.2	3.0
2. Thiocarbamide	1.0	2.0	2.1	5.0
3. Sodium- or Potassium Hydroxide	.6	2.0	6.2	6.5

Other concentrations may be found as useful or even better for the purpose. That depends greatly on the room temperature, which best is taken between 20 and 25°C. equal to 68-78°F.

The coating with lead sulphide is done in the following way: The glass is prepared as for ordinary silvering. That means it must be extremely well polished, washed with distilled water, then with the usual solution of stannous chloride, and cleaned again with distilled water. The wash water is now removed and the glass is either rocked in a bath of the coating solution or the solution is poured on to the still wet plate and allowed to stand for about 10-20 minutes.

The coating solution is mixed from equal parts of the three solutions mentioned in the table above. When the lead sulphide is deposited, the scum is carefully removed with a wet leather, and, if necessary, a second coat is applied in the same way. Sometimes even a third coat may be given. Eventually the plate or the glass is again carefully cleaned, rinsed with distilled water, dried and varnished and painted as usual. The sulphide film adheres fast to the glass; and when the glass is carefully washed and well protected with varnish and paint, the gray-blue mirror may last as long as a mirror of silver.

Gold mirrors or, more exactly in the sense of this survey, glass mirrors coated with gold, were produced as early as 1855. They may even have been manufactured prior to that time by sticking gold leaf to glass. But a perfectly reflecting mirror cannot be produced by this method. In that year Mr. Tony Petitjean published in E. P. 1681/1855 a method of gilding by chemical means, similar to silvering by the rochelle salt process. Nearly at the same time Prof. Liebig published a recipe for gold mirrors. Then followed Schwarzenbach E. P. 208/1873; Prof. Boettger; James Pratt E. P. 12014/1885, who was a very clever silverer; and then many others of whom we may enumerate Dr. Felix Hermann, G. P. 147562 and 178523; Camille Boirre, E. P. 28605/1910; Coles-Cowper, E. P. 2396/1909; Gustav A. Bauer, E. P. 4385/1908; William La Hodney, A. P. 1744316; Felix A. Andres, A. P. 1953330; Joseph Karfunkel; and the author of this article.

The principle of all processes is to neutralize a weak solution of gold chloride in water or to make it slightly alkaline and then to reduce it with one of the reducing agents used in the silvering line or with a mixture of them. Alcohol, glycerine, inverted sugar, glucose, citric acid, formaldehyde, etc., are employed for the purpose.

One of the formulas often mentioned and first recommended by Prof. Boettger is given on the following page:

1. FORMULA FOR GOLD MIRRORS

Solution No. 1 2 grams Gold Chloride (50-51%) to be dissolved in 120 cc distilled water.

Solution No. 2 6 grams Sodium Hydroxide (Caustic Soda) to be dissolved in 100 cc dist. water.

Solution No. 3 2 grams Glucose (Grape Sugar) to be dissolved in 24 cc dist. water and added to 24 cc Alcohol (80%) and 24 cc Formaldehyde.

For gilding to be mixed:
64 parts of solution No. 1
16 parts of solution No. 2
1 part of solution No. 3

The recipe, if carefully handled, works well. It is found, however, that the neutralization with sodium hydroxide is rather difficult, as the slightest excess of it increases the sensibility of the solution towards the reducing solution in such a way that lumps of gold scum are built within the solution before gold crystals settle on the glass. The substitution of sodium carbonate for sodium hydroxide helps a great deal in this respect. It allows at the same time simplifying the reducing solution No. 3, using a diluted solution of formaldehyde only. The following formula represents this type of recipes:

2. FORMULA FOR GOLD MIRRORS

Solution No. 1 3 grams Gold Chloride (50-51%) dissolved in 80 cc dist. water.

Solution No. 2 8 grams Sodium Carbonate (Crystals) dissolved in 80 cc dist. water.

Solution No. 3 5 cc Formaldehyde (40%) diluted with 80 cc dist. water.

For gilding to be mixed equal parts of the three solutions.

This formula, as well as the previous one, uses an extraordinarily high concentration of gold of 1 gram gold chloride in 80 parts of the final solution; that is a concentration of 1.25 per cent; whereas the strength of an ordinary silvering solution is about 0.3 per cent on the average. That would exclude the use of these formulas for practical purposes, because of the high price of gold chloride. It is, however, possible to use the formulas in such a dilution with water that their concentration is only about 0.1 per cent. The strength necessary depends, as we shall see, on how the solutions are used.

The application of the gold solution is similar to the methods of silvering. The glass, which is carefully cleaned in order to degrease it completely, is first washed with the solution of tin chloride, "tinned," using a somewhat stronger concentration than usual, then washed with distilled water and, still wet but with as little wash-water left as possible, treated with the gold solution. This treatment can be done in three different ways: First, the gold solution is poured on and allowed to stand on the plates for about twenty minutes. The concentration of the solution may be about 0.2 per cent. Secondly, the glass is rocked in a bath of the solution, the concentration being about 0.1 per cent. Thirdly, the solution is sprayed against the glass, for which purpose the solution must be highly concentrated as far as 1.25 per cent. The best temperature for the first two methods is about 25°C. or 78°F. whereas, for the third method the temperature may be raised to about 30°C. or 86°F.

If the solutions are well balanced their mixture will remain clear for most of the time. In the later stage of the process the solution becomes of a grayish-blue appearance. The gold film settles down first as a thin bluish veil, gradually getting thicker and darker blue. It is not necessary that the coat becomes completely opaque or even golden, although it turns out to be so in the later stages. But the reflected light must show a golden or rather brown tone. Then the solution is thrown away and the glass carefully and thoroughly washed with distilled water without touching it with the fingers or with the leather. It is very rarely that the film adheres closely enough to the glass to be directly protected by varnish and point. As a rule the thin gold film has to be protected by a layer of silver applied immediately after the washing in the usual way of silvering. Then the glass is dried and varnished and painted in the ordinary way.

The experienced silverer will certainly succeed without great trouble in turning out gilded glasses of high perfection. The above-mentioned drawback, that the solution turns too quickly, still persists to a certain degree in spite of the use of sodium carbonate instead of hydroxide. Therefore, some craftsmen use an additional chemical as a stabilizer without disclosing their secret to anybody other than their customers. Using a formula with stabilizer gilding is nearly as easy to do as silvering.

Quite recently another chemical method of making gold mirrors has been evolved. About a year ago at the British Association Meeting at Cambridge, England, Professor Charles S. Gibson and Dr. F. H. Brain demonstrated the production of gold films by the decomposition of organic gold compounds at the ordinary temperature. The author of this article later on had the privilege of being shown the process privately by the inventors. The method works quite well, approximately in the same way as a formula using a stabilizer. The organic compound, however, is of highly complicated character, which can easily be understood from the fact that one of the organic gold compounds from which brilliant gold films can be obtained bears the name acetylacetonediethyl-gold and the special gold preparation is not yet on the market. Another inconvenience of this new method is that the organic compound is soluble only in organic solvents such as alcohol and not in water. It may also be more expensive than the usual method. One advantage of the method is that the thickness of the desired gold film can be fairly accurately calculated in advance. That fact makes this method valuable for some scientific appliances.

Gold mirrors always have had a special attraction both for scientists and mirror makers. In by-gone times, magical properties were attributed to them, and even today they are the criteria of excellence. Their practical value lies mostly in their application to decorative and advertising purposes, where the chemical method of depositing gold very often not only gives better results, but is also considerably cheaper and simpler than the use of gold leaf. It is therefore certain that they will be favored in the future still more than in the past.

Copper mirrors, with their pink appearance, had from the first, and are still having a much wider field. Although silver reflects all colors of the spectrum with equal value, and although the image from ordinary looking-glasses should consequently show natural colors, that is not actually the case—the greenish or bluish tint of the glass through which the rays have to pass twice (entering and being reflected) makes the image pale and insipid. However, the person who wants to view himself critically prefers, as a rule, to be flattered and to find

himself rosy and healthy looking. Hence hairdressers, beauty parlors, restaurants and the like, are learning more and more to hang pinkish tinted mirrors on the walls. Mostly, pink glass is used for such purposes; but the copper mirror will come to be preferred because of its cheapness, as soon as it is possible to produce this type of looking-glass easily on a commercial scale.

Whereas it was relatively easy from the outset to deposit the precious metals, silver and gold, from their solutions in correspondence with their chemical properties, it was a much more difficult problem to reduce copper by chemical means and to deposit it upon glass as an adhering and reflecting film. It is therefore not to be wondered at that a successful method for accomplishing this was unheard of, until towards the end of the last century.

As far as can be ascertained, it was Dr. Weiskopf of Morchenster, Bohemia, who gave the first recipe for coppering glass chemically in the G. P. 124710. This prescription is of special interest, because it not only gave an impetus to this kind of "silvering" but it remains the basis of the processes most widely used today. He employed formaldehyde as a reducing agent. In the first decade of this century several formulas were published. P. Neogi gave a prescription very similar to that of Dr. Weiskopf. F. D. Chattaway used phenylhydrazine for reducing the copper salt. Dr. Kurt Bamberger and Dr. Robert Schweizer, G. P. 420469, and T. D. Smith, E. P. 152835 introduced the use of hydrazine sulphate. This was also used by E. A. H. French during the war (1914-1918) with quite good results in producing copper mirrors for special search lights. Several other specialists have worked and are still working on the development of copper depositing processes, of whom we will mention only Paolo Miscatelli, Joseph Karfunkel, William Peacock and the author of these lines. All of them have used formaldehyde as reducing agent, so far as we know.

The formula of Dr. Weiskopf, in its original form, used two solutions:

1. FORMULA FOR COPPER MIRRORS

Solution I.
1. 100 parts of a sol. of Copper Chloride in dist. water at the ratio 1:5,
2. 2 parts sol. Chloride of Platinum or Gold in water, 1:10,
3. 2 parts sol. Zinc Chloride, 1:5,
4. 50 parts sol. Ammonium Nitrate, 3:100
5. 100 parts sol. Rochelle Salts, 1:2,
6. 200 parts sol. Caustic Soda, 1:10.

Solution II.
1. 2 parts sol. Cane Sugar, 1:20,
2. 1 part sol. Glycerine, 1:10,
3. 1 part Formaldehyde (40%).

Mix 454 parts of Solution I with 1 part of Solution II.

The chemist will easily see that the main parts of Solution I, namely 1, 5 and 6, constitute a kind of Fehling's Solution. The part that No. 3 and 4 play is not quite clear; it is found, however, that the formula works less reliably without them. As to No. 2, the addition of chloride of platinum or gold is very essential. If they are omitted, no useful mirror can be obtained. The copper would not settle on the glass, and if it did the layer would be dull an not reflecting. The addition of the chloride of one of these precious metals makes the coat bright and reflecting. Gold chloride works better than platinum chloride, and provides a warmer and more colorful tone. Besides, the presence of the gold or platinum chloride accelerates the reaction considerably. People have often attempted to replace these expensive metals by silver, but so far without success; even when copper sulphate was substituted for copper chloride. The silver is too quickly thrown out of the solution by the formaldehyde present, whereas gold or platinum may settle on the glass as invisible crystals giving a basis for the copper to accumulate.

For practical work on a larger scale the original formula had to be varied and simplified. A modern form of this type of copper-depositing processes may be presented:

2. FORMULA FOR COPPER MIRRORS

Solution I. 215 grams Copper Bichloride,
16 grams Zinc Chloride,
4 grams Gold Chloride
to be dissolved in 1750 cc water.

Solution II. 735 grams Rochelle Salt in 1650 cc water.

Solution III. 355 grams Caustic Soda,
380 grams lump Sugar,
325 cc Glycerine, all in 1215 cc water.

Solution IV. 9 grams Ammonium Nitrate in 2100 cc Formaldehyde (40%). No water!

For Coppering to be mixed:
3 parts of distilled water with
1 part of each of the four solutions.

The application of the mixture for coppering is again similar to the process for ordinary silvering. The carefully polished glass is washed with a solution of tin crystals, as usual, or with slightly alkalized water, in order to roughen the surface invisibly and make it fit for the deposition of copper. After washing with distilled water, the glass is covered with the copper solution, either by pouring or preferably by bathing and rocking the glass in the mixture. The copper settles down as a hard layer of metallic copper of a red color which, after careful cleaning with a soft leather and distilled water, can directly be varnished and painted. Often one coat is not enough, and a second has to be applied. The room temperature must be somewhat above the average, about 30°C or 86°F. The deposition takes about 20-30 minutes. The mirror is of a bright and very pleasant appearance, the reflected image being of a distinctly pink color.

A variation of this method deposits copper on glass which is previously coated with a very thin, still completely transparent layer of silver. As in this case the basis for the copper to settle on is delivered by the silver underneath, gold or platinum can be omitted from the formula, and it can also be simplified in other ways. One of the least complicated formulas has been developed by Paolo Miscatelli:

3. FORMULA FOR COPPER MIRRORS

Solution I. 4 grams Copper Sulphate,
15 grams Rochelle Salt,
9 grams Caustic Soda,
all dissolved in 1000 cc dist. water.

Solution II. 200 cc Formaldehyde.

For coppering, Solution II to be added to Solution 1.

As said before, the glasses have to be weakly silvered prior to coppering. The advantages of this method is that it is decidedly cheaper and that different colors varying from pure silver to reddish pink can be produced. On the other hand, it is difficult to obtain the same tone each time and the mirrors are neither so even nor so bright and powerful as those of gold.

All three formulas mentioned contain formaldehyde as the main reducing agent. Formeldehyde has an unpleasant, stinging smell, and smarts the eyes. Further, the reaction develops hydrogen which has a tendency to penetrate throuh the layer of copper, and results in blistering. It would therefore be highly desirable if the formaldehyde could be replaced by a suitable reducing agent lacking these detrimental properties. However, provided

the formulas are carefully balanced, these processes seem to be the best available at the present time.

Chattaway's prescription with phenylhydrazine instead of formaldehyde needs careful handling:

4. FORMULA FOR COPPER MIRRORS

Solution I. 1 part Phenylhydrazine, freshly distilled, 2 parts dist. water, warmed until clear.

Solution II. Concentrated solution of Copper Hydrate in concentrated Ammonia.

Solution III. 10 parts Caustic Potash in 100 parts distilled water.

For coppering, mix two parts of Sol. I with one part of Sol. II, warm and add Sol. III after being warmed, in such a quantity that a permanent turbidity from precipitating copper monohydrate results. Bring the glass into the colorless or weakly yellow solution for about an hour and warm slowly.

It may be mentioned that preparation of the glasses with tin chloride has proven useless in all cases where a relatively high temperature is employed.

Substituting hydrazine sulphate for phenylhydrazine simplifies the procedure and makes it more reliable. Bamberger and Schweizer use a relatively weak solution:

5. FORMULA FOR COPPER MIRRORS

Solution I. 50 grams Copper Sulphate and 100 cc concentrated Ammonia are dissolved in 1000 cc dist. water.

Solution II. 19 grams Hydrazine Sulphate dissolved in 2000 cc dist. water.

Solution III. 20 grams Caustic Soda in 1000 cc dist. water.

For coppering mix 1 part Sol. I,
2 parts Sol. II, and
1 part Sol. III.

Bring the glass into the solution and warm until 70-100°C (158-212°F) for the purpose of acceleration.

In a similar way but with far stronger solutions, E. A. H. French worked:

6. FORMULA FOR COPPER MIRRORS

Solution I. Concentrated solution of Copper Hydrate in concentrated Ammonia (.88).

Solution II. 60 grams Hydrazine Sulphate in 1000 cc dist. water.

Solution III. 111 grams Caustic Potash in 1000 cc dist. water.

Mix 90 cc of Sol. I, while agitating, with 150 cc of Sol. II which has been warmed to 60°C. (140°F). Rinse glass before coppering with this solution. Add 87.5 cc Sol. III of about 60°C. (140°F.), keep at a temperature of about 43°C. (110°F.), immerse the glass to be coppered immediately and warm by degrees to 57°C. (135°F.).

The solution which was of a clear, yellow color in the beginning turns first dark-green, then pink. After about 20 minutes the copper mirror is formed. A second coat can be applied in the same way. The mirror has a pleasant appearance, bright and red.

In the foregoing, we have tried to describe most of the practical methods of making colored mirrors by chemical means. We have described these processes as Colored "Silvering," because the mirror manufacturer describes as "silvering" any deposition of metals or metal compounds on glass that will produce looking glasses, whether or not these deposits contain silver. Two other methods of depositing metals on glass or other material exist: The Sputtering, and the Evaporating Processes. These physical operations, of course, are of an entirely different nature. Up to the present time, because of their limitations with respect to size and cost, these methods cannot be said to compete commercially with the chemical processes.

NATIONAL DEFENSE PROCUREMENT

The Department of Commerce, Bureau of Foreign and Domestic Commerce, Washington, has prepared a list of Army and Navy procurement field offices for those who are interested in assisting the government in their drive for unification of national defense needs.

The War and Navy Departments state that current information of this type can best be secured from their field offices, rather than by writing to Washington or by sending representatives to Washington. The Navy Department maintains 27 major field purchasing offices in 23 cities, while the War Department has 46 major field procurement offices in 22 cities.

This list of National Defense Information may be obtained from the field offices of the War and Navy Departments, or may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C.

A TRIBUTE TO GLASS

A tribute to glass has made its début on the back of sales letters of the George F. Collins and Company, manufacturers of glass specialties of Sapulpa, Oklahoma. The author, George J. Overmyer, is a member of the company, and we print his Tribute to Glass with his permission.

I AM GLASS

I am created of the admixture of Earth's minerals, formed by the alchemy of time
I am born transformed in the blasting heat of fiery furnace
In molten mass I am tediously fashioned by the hand of cunning Artisan—or fed into the maw of intricate machine
I assume ten thousand hues of all the spectrum—either transparent, translucent or opaque—upon my maker's will
I can masquerade as ruby—emerald—topaz—moonstone; and all the other priceless jewels of man
But frivolous baubles are not my aspiration—I serve ten million purposes in as many different places, forms and ways
My duties are unnumbered—infinite; pay heed to my utility:

I admit the Heavenly light to hovel, palace or cathedral, and yet repel cold winter's howling breath
I faithfully project the light that warns great ships from shoal and concentrate the beams that guide swift vehicle through storm and gloom of night to bring the wayfarer safe home
I visibly contain my master's food—his drink—and countless other of his commodities; protecting them in transport and in the mart and home
I form the shell of glowing bulb and tube to diffuse his artificial light—and to disseminate his advertising
I am the walls of his abode, his office and his factory—and objects of utility and art in each of these
I reflect his image—and mark the effects of time upon his person —sometimes I flatter but more often am critically severe
I correct his impaired sight and thus bestow enjoyment of the printed word—and all of Nature's beauties roundabout
I magnify his minute, unseen enemies and thereby do I promote his health and happiness
I form the gossamer thread from which is fashioned fine raiment—yet too the insulation of his dwelling
I reveal to him the mysteries of his Universe—carrying his vision to the illimitable reaches of the outer stars
Through me he learned to chart the Firmament—to plot the orbits of the Planets and predict the courses of the Comets and Eclipses

This knowledge I unfold is but the pledge of vaster knowledge as —step by step—I lead him to unexplored, immeasurable spaces
For I am older than the Pyramids yet newer than tomorrow's unborn dawn—withal the marks of time affect me not—for I am ageless and retain my lustrous beauty permanently
Some of my tasks I have recounted—but this is only the beginning; for those who make me and adapt me to their uses, are men of vision—and together, as time unfolds, we will go far
And so—in modesty I proclaim—I am Man's invaluable and versatile servant—I AM GLASS

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COMBUSTION CALCULATIONS FOR A CONTINUOUS GLASS MELTING FURNACE

By R. L. SHUTE and R. K. HURSH
University of Illinois

This article is an attempt to show how the conditions of combustion in a glass tank furnace may be estimated from a knowledge of the compositions of fuel gas, air, and batch entering the furnace, and of the flue gas and glass leaving it. It deals particularly with the gases generated from the batch, and their effect on flue gas composition. Methods are described for calculating the true excess of air admitted and the loss of heat in the stack gases.

In the process of glass melting an appreciable amount of gas is given off by the raw materials of the batch. These gases consist of carbon dioxide, water vapor, sulphur dioxide or sulphur trioxide. The water vapor does not appear in the flue gas analysis and the other constituents may generally be considered as included in the CO_2 determination. These diluting gases therefore have no effect on the percentage of oxygen, nitrogen and carbon monoxide as shown by the flue gas analysis. There are other combustion calculations, however, in which the diluting gases of the batch affect the results to some extent.

Combustion in Furnace

The problem of combustion in a glass furnace is somewhat simplified by consideration of the following general rules.

1. Everything entering the furnace must appear either in the melted glass or in the products of combustion.
2. Carbon in the fuel or batch appears as carbon dioxide or carbon monoxide in the flue gas.
3. Nitrogen appearing in the flue gas usually comes from the air and bears a fixed relation to it. If it appears in the analysis of the fuel gas a correction should be made for it.
4. In an Orsat analysis both the gas sample and the constituents as measured are saturated with water vapor at a constant temperature. The proportions of the constituents are therefore the same as in a moisture free mixture and the gas analysis is on a "dry basis."

The materials entering the furnace are

1. Gas (either artificial or natural) or oil containing various constituents as shown by the analysis.
2. Air, containing oxygen, nitrogen and water vapor.
3. Batch consisting of several materials, some of which give off gases or water vapor.

A knowledge of the chemical reactions which take place within the furnace is necessary if the calculations are to be carried out completely.

The following data from a large continuous furnace will be used as a specific example for calculation.

Tons of glass melted in 24 hrs.	86.2
" " cullet filled " " "	32.0
" " batch " " " "	60.5

Fuel, natural gas 1150 B. T. U. per cu. ft., equivalent to 1058 B. T. U. per cu. ft. net value.

Gas consumption per ton of glass melted 13,410 cu. ft.

Batch composition	
Sand	100 lbs.
Burnt lime	20 "
Soda ash	28 "
Salt cake	7 "
Carbon	0.21
Total	155.21

Analysis of natural gas		*per cent*
Carbon dioxide	CO_2	0.0
Oxygen	O_2	0.0
Hydrogen	H_2	0.8
Carbon monoxide	CO	0.5
Methane	CH_4	77.9
Ethane	C_2H_6	20.6
Nitrogen	N_2	0.2

Analysis of flue gas, samples averaged from ports on outgoing side.

Carbon dioxide	CO_2	11.0
Oxygen	O_2	3.0
Carbon monoxide	CO	0.0
Nitrogen	N_2	86.0
Total		100.0

Atmospheric conditions	
Air temperature	70° F
Relative humidity (R. H.)	70%
Flue gas temperature at damper	900° F

From this data it is desired to find the following:

(a) Theoretical volume of air required per cu. ft of fuel gas.

(b) Per cent of excess air.

(c) Volume of air supplied per cu. ft. of fuel gas.

(d) Heat loss from unburned gas in products of combustion.

(e) Volume of gas produced per hour from batch materials.

(f) Volume of dry flue gas produced per hour.

(g) Total volume of (wet) flue gas produced per hour.

(h) Amount of heat carried away per hour in the flue gases.

When an anlysis of the fuel gas is available, the first step is to find the products of combustion and their theoretical volume, by means of the chemical equations for the furnace reactions of the various constituents of the fuel gas.

*Some of the most commonly used equations for these reactions, written to include nitrogen from the air, are as follows:

$$C + O_2 + 3.76N_2 = CO_2 + 3.76N_2$$
$$2C + O_2 + 3.76N_2 = 2CO + 3.76N_2$$
$$2CO + O_2 + 3.76N_2 = 2CO_2 + 3.76N_2$$
$$2H_2 + O_2 + 3.76N_2 = 2H_2O + 3.76N_2$$
$$CH_4 + 2O_2 + 7.52N_2 = CO_2 + 2H_2O + 7.52N_2$$
$$C_2H_6 + 7O_2 + 26.33N_2 = 4CO_2 + 6H_2O + 26.33N_2$$

Based on analysis of the natural gas used for fuel in

this problem, the theoretical volume of oxygen and products of combustion are as follows:

Product	per cent	Fraction of cu ft.	Oxygen reqd. per cu. ft.	Products of Combustion: Carbon Dioxide	Water	Nitrogen from fuel
CO_2	...	...	...	...	...	...
O_2	...	...	...	...	...	...
H_2	0.8	.008	.004	...	.008	...
CO	0.5	.005	.0025	.005	...	...
CH_4	77.9	.779	1.558	.779	1.558	...
C_2H_2	20.6	.206	.721	.412	.618	...
N_2	0.2	.002	...	...	...	.002
(1) Totals	100.00	1.00	2.285	1.196	2.184	.002

The answers to questions a, b and c may now be computed.

(a) Theoretical Air Requirement.

Since 2.285 cu. ft. of O_2 are required for each cu. ft. of fuel gas, the air necessary to supply this amount of oxygen is equal to

$$\frac{2.285}{.21} = 10.88 \text{ cu. ft.}$$

(b) Per cent Excess Air.

The per cent excess air represents the ratio of unused air to that actually used in combustion. Excess air is represented by the O_2 in the gases less the amount that would have been required to complete the combustion of any CO present. The total supplied, which includes excess air and air used, is represented by the N_2 in the flue gases. In the following formula the O_2 in the total air supplied is represented by the item $N_2 \times \frac{21}{79}$. The excess air is then calculated by the ratio of excess O_2 to the O_2 actually used in combustion.

The per cent excess air is computed from the flue gas analysis by the formula

$$\text{Excess air} = \frac{O_2 - 1/2\,CO}{N_2 \times 21/79 - (O_2 - 1/2\,CO)} \times 100$$

Since no CO is present this becomes

$$\frac{O_2}{N_2 \times 21/79 - O_2} \times 100 = \frac{.03}{(.86 \times .266) - .03} \times 100 = 15\%$$

(c) Total air supplied.

Air supplied per cu. ft. of fuel gas = theoretical air + excess air = 10.88 + (10.88 × .15) = 11.31 cu. ft.

(d) Heat Loss from Unburned CO.

Since the flue gas analysis discloses no CO, heat loss from that source is zero. To illustrate the method of computing heat loss when CO is present let it be assumed that the flue gas analysis is as follows:

CO_2	11%
O_2	3%
CO	2%
N_2	84%

Substituting these values in the formula used above, the percentage of excess air for this condition is then

$$\frac{.03 - .01}{(.84 \times .266) - (.03 - .01)} \times 100 = 9.8\%$$

From answer (a) above it is seen that each cu. ft. of natural gas requires 10.88 cu. ft. of air for combustion and from the equation just solved that an excess of 9.8 per cent is supplied. The air supplied is therefore 10.88 cu. ft. + (.098 × 10.88) = 10.95 cu. ft. per cu. ft. of fuel gas. The total input of gas and air is therefore 1 + 10.95 = 11.95 cu. ft. of gas and air mixture, called the combustible.

The natural gas used for fuel yields 1058 B. T. U. per cu. ft. which is equal to $\frac{1058}{11.95} = 88.5$ B. T. U. per cu. ft. of combustible. A cu. ft. of CO when burned to CO_2 gives off 323 B. T. U. and for each cu. ft. of combustible 2 per cent or .02 cu. ft. of CO is lost. The heat lost per cu. ft. of combustible is therefore .02 × 88.5 = 1.7 B. T. U. The percentage of heat lost per cu. ft. of combustible is equal to

$$\frac{\text{B. T. U. lost}}{\text{B. T. U. per cu. ft. of combustible}} \times 100 = \frac{1.7}{88.5} = 2.1\%$$

(e) Calculation of volume of Gas Produced from batch.

From the data given, 60.5 tons of batch are melted in 24 hours, or 5041.7 lbs. per hour. Of this amount the various raw materials based on 155.2 pounds as a unit fill are apportioned as follows:

Silica $\frac{100}{155.2} \times 5041.7 = 3252$ lbs. per hour

Lime $\frac{20}{155.2} \times 5041.7 = 650.4$ " " "

Soda $\frac{28}{155.2} \times 5041.7 = 910.5$ " " "

Salt cake $\frac{7}{155.2} \times 5041.7 = 227.6$ " " "

Carbon $\frac{21}{155.2} \times 5041.7 = 6.8$ " " "

No gases are given off from the silica or lime in this case as the latter is already in the form of an oxide. If limestone ($CaCO_3$) were being used instead of burnt lime CO_2 would be evolved according to the following equation:

$$CaCO_3 + \text{heat} = CaO + CO_2$$

$$x \text{ lbs.} \times \frac{44 \text{ (Molecular wt. } CO_2)}{100 \text{ (Molecular wt. } CaCO_3)} = y \text{ lbs. } CO_2$$

The calculations are simplified by converting pounds to cu. ft. by the ratio

$$\frac{\text{*Pounds of gas}}{\text{Molecular wt. of gas}} \times 359 = \text{cu. ft., or}$$

$$\frac{Y \text{ lbs. } CO_2}{44 \text{ (Molecular wt. } CO_2)} \times 359 = \text{cu. ft. } CO_2 \text{ per hour.}$$

(2) For the soda in the batch

$$Na_2CO_3 + \text{heat} = Na_2O + CO_2$$

$$910.5 \text{ lbs.} \times \frac{44 \text{ (Molecular wt. } CO_2)}{106 \text{ (Molecular wt. } Na_2CO_3)} = 378 \text{ lbs. } CO_2 \text{ per hr.}$$

$$\text{or } \frac{378 \text{ lbs. } CO_2}{44} \times 359 = 3072 \text{ cu. ft. } CO_2 \text{ per hr. from soda ash.}$$

(3) For the salt cake

$$Na_2SO_4 + SO_2 = Na_2SO_3 + SO_3 + O_2$$

$$227.6 \text{ lbs.} \times \frac{80 \text{ (Molecular wt. } SO_3)}{142 \text{ (Molecular wt. } Na_2SO_4)} = 128.2 \text{ lbs. } SO_3 \text{ per hr. or}$$

$$\frac{359}{80} \times 128.2 \text{ lbs. } SO_3 = 576.9 \text{ cu. ft. } SO_3 \text{ per hr.}$$

The SO_3 later breaks down into SO_2 and O_2. In an Orsat analysis of flue gas the SO_2 is subject to absorption

by the KOH solution in the same manner as CO_2 and is therefore grouped with it. This volume of SO_2 is relatively unimportant as is also the O_2 evolved from the same reaction.

(4) For carbon in batch

$$C + O_2 = CO_2$$

$$6 \text{ lbs.} \times \frac{44 \text{ (Molecular wt. } CO_2)}{12 \text{ (Molecular wt. C)}} = 24.9 \text{ lbs. } CO_2$$

$$24.9 \times \frac{359}{44} = 204 \text{ cu. ft. } CO_2 \text{ per hour from carbon in batch.}$$

The volume of gas from batch materials is therefore

$$3072 + 204 = 3276 \text{ cu. ft. per hour}$$

(f) Volume of dry flue gas.

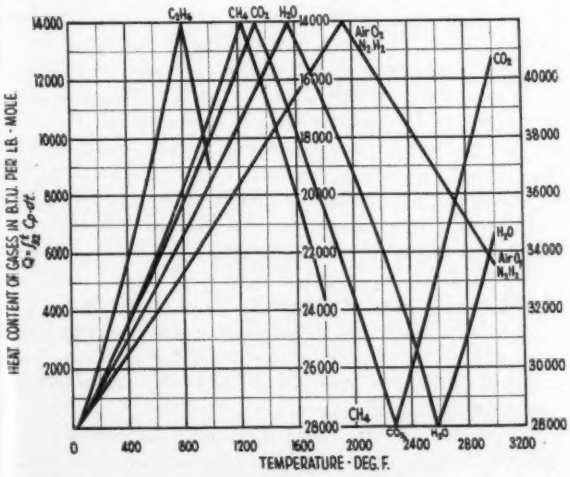
From the data given, $\frac{86.2}{24} = 3.6$ tons of melted glass produced per hour. At 13,410 cu. ft. gas used per ton of melted glass the fuel consumption is $3.6 \times 13{,}410$ cu. ft. $= 48{,}276$ cu. ft. per hour.

From the combustion calculations item No. 1 it is seen that 1.196 cu. ft. of CO_2 is produced per cu. ft. of gas burned. The volume of CO_2 produced from combustion is therefore $1.196 \times 48{,}276 = 57{,}740$ cu. ft. per hr. In addition to this is produced from soda 3072 cu. ft. per hr. and from carbon 204 cu. ft. per hour, making a total of 61,016 cu. ft. CO_2 per hour. By analysis, this volume of CO_2 represents 11.0 per cent or .11 cu. ft. for each cu. ft. of dry flue gas.

The volume of dry flue gas is then $\frac{61{,}016}{.11} = 555{,}000$ cu. ft. per hour. Breaking this down into its various constituents gives

CO_2—11%	61,016 cu. ft. per hour
O_2— 3%	16,650 " " " "
N_2—86%	477,334 " " " "

To be strictly accurate, the small amount of N_2 in the fuel glas, which amounts to .2 per cent or .002 cu. ft. per cu. ft. of natural gas burned, ($.002 \times 48{,}276 = 96$ cu. ft. N_2 per hr.), should be subtracted from the total N_2 given above. This small volume of N_2 can be neglected since the accuracy of the flue gas analysis does not warrant its retention.



Temperature Heat Content Chart for Gases

As a check on the accuracy of the flue gas analysis, the percentage of excess air may be computed by another method. Referring again to data under item No. 1, it is seen that each cu. ft. of fuel gas requires 2.285 cu. ft. of O_2 for perfect combustion. The air required to furnish this amount of oxygen is then

$$\frac{2.285}{.21} = 10.88 \text{ cu. ft. per cu. ft. of fuel gas.}$$

The theoretical amount of air supplied is therefore $10.88 \times 48{,}276 = 524{,}243$ cu. ft. of air per hour required for perfect combustion. It has been shown by the preceding calculations that 86 per cent of the dry flue gas or 477,334 cu. ft. per hour is nitrogen. The air supplied is given by the ratio.

$$\frac{N_2}{.79} \text{ or } \frac{477{,}334}{.79} = 605{,}000 \text{ cu. ft. per hour}$$

Excess air is therefore:

$$\frac{\text{air supplied} - \text{air required}}{\text{air required}} \text{ or } \frac{605{,}000 - 524{,}234}{524{,}234} \times 100 = 14.9\%$$

which agrees closely enough with the previous figure of 15 per cent excess air obtained. If these two methods of calculating the excess air do not agree, a check should be made of the flue gas analysis.

(g) Volume of total flue gas.

Air is assumed to enter the furnace at 70° F. and 70 per cent relative humidity and the water vapor carried with it under these conditions is given by humidity tables as .011 lbs. per pound of dry air.

To compute the volume of water vapor carried into the furnace per hour by the combustion air it is converted from cubic feet to pounds by the ratio,

$$\frac{605{,}00 \text{ cu. ft. air}}{359 \text{ cu. ft.}} \times 29 \text{ (Molecular wt. of air)} = 48{,}900 \text{ lbs. air per hr.}$$

$48{,}900 \times .011$ lbs. water per lb. air $= 537$ lbs. water per hr. Converted to a volume basis, this amount of water becomes

$$\frac{537 \text{ lbs. } H_2O}{18 \text{ (Molecular wt. } H_2O)} \times 359 \text{ cu. ft.} = 10{,}720 \text{ cu. ft. water vapor per hr.}$$

Referring again to data under item No. 1, each cubic foot of gas burned produces 2.184 cu. ft. of water vapor. From this source then there is $2.184 \times 48{,}276$ cu. ft. gas burned per hr. $= 105{,}430$ cu. ft. water vapor per hr. The total volume of water vapor in the flue gases is then $105{,}430 + 10{,}720 = 116{,}150$ cu. ft. per hour.

The total volume of the products of combustion is therefore

Oxygen	16,650 cu. ft. per hr.
Garbon dioxide	61,016 " " " "
Nitrogen	477,332 " " " "
Water Vapor	116,150 " " " "
(g) Total	671,150 Cu. Ft. per hr.

(h) Heat Content of Flue Gas

Having arrived at the total volume of flue gas and the amounts of the various gases comprising it, a calculation of the amount of heat carried out of the stack can now be made.

(*Continued on page* 369)

CURRENT STATISTICAL POSITION OF GLASS

June activity in the glass industry held to May's level. Increases in miscellaneous glassware branches counteracted declines in other groups, bringing employment and payrolls slightly higher. Exports continued strong as imports dropped to a low record. According to THE GLASS INDUSTRY'S production index, output during June equaled May's total of $29,000,000—registering an increase of 8 per cent over last year's comparable period. During the first half of 1940, glass production totaled about $175,000,000, which compares favorably with $150,000,000 in 1939, and $183,000,000 in 1937 (the industry's record year).

Plate glass production during June amounted to 9,783,139 square feet according to the Plate Glass Manufacturers of America. This was a drop of 17 per cent from the previous month, but was 5 per cent greater than June 1939. During the first six months of 1940 plate glass output totaled 78,604,000 square feet, which was 34 per cent greater than in last year's comparable period.

Window glass production totaled 907,865 boxes in June, which represented a decrease of 15 per cent from the previous month, but was 26 per cent larger than June of last year. Output in the window glass industry during the first half of 1940 amounted to 6,619,000 boxes, or more than 36 per cent greater than last year.

Glass container output during June amounted to 4,428,904 gross, according to the Glass Container Association of America. This was 6 per cent below May's figure and 5 per cent less than June 1939. For the first time since November 1938 manufacturing activity in this industry failed to equal that of the previous year's comparable month. On the other hand, shipments during June soared to the highest monthly volume on record, registering a total of 5,229,535 gross (the previous record was set in June 1937 with a volume of 5,174,000 gross). This year's June shipments were 10 per cent greater than May's, and 13 per cent more than June of last year. Stocks on hand as of June 30 amounted to 9,179,587 gross—9 per cent below May, but 12 per cent above last year's comparable period.

During the first half of 1940 the glass container industry set a new production record with an output of 26,706,000 gross—10 per cent greater than last year and 1 per cent greater than in 1937 (the industry's best year). Shipments during the January-June period totaled 26,116,768 gross—an increase of 11 per cent over last year and within 2 per cent of 1937.

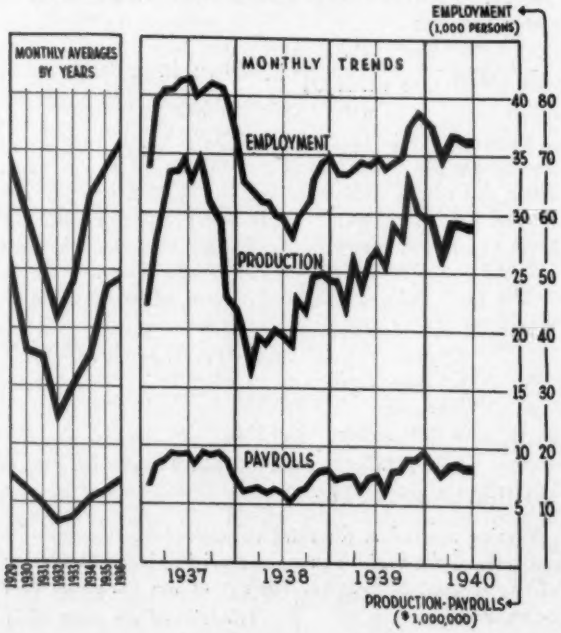
Miscellaneous glass products manufactured during June were valued at $10,000,000, according to reliable estimates. This was an increase of about 10 per cent over last month, which is largely attributed to increased production of technical, scientific and industrial lines, continued expansion in handmade tableware, production of light bulbs to supply areas formerly purchasing their requirements in countries at war. Activity in the illuminating glassware branch of this industry continued at May's level, but dropped at least 15 per cent behind June of last year. It is estimated that products of miscellaneous glass products during the first half of 1940 exceeded last year's volume by 17 per cent.

Employment and Payrolls: Approximately 73,000 persons were employed in the glass industry during June, representing an increase of about 400 over May. This compares favorably with June 1939 when employment was estimated at 69,000.

Payrolls in the glass industry during June totaled $8,200,000, which was slightly above last month's level. During the first six months of this year glass manufac-

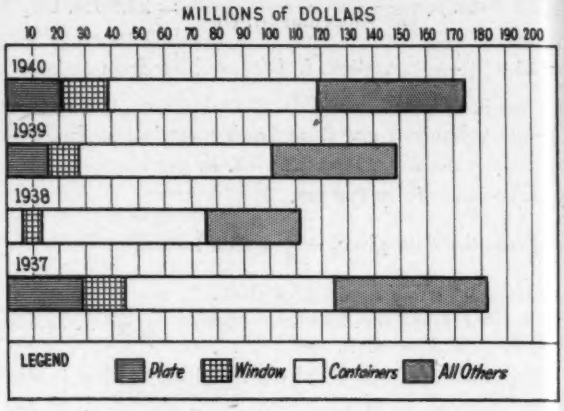
THE GLASS INDUSTRY'S INDEX

Monthly Trends Through June, 1940



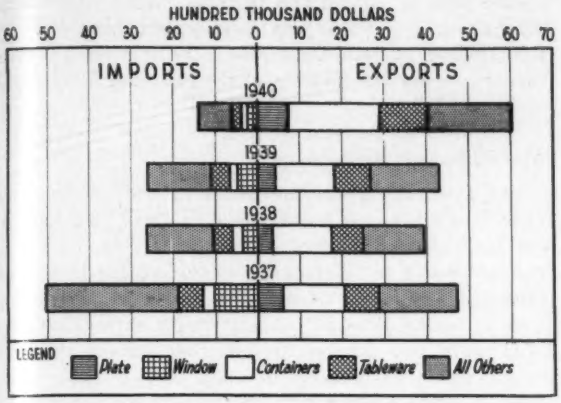
THE GLASS INDUSTRY'S INDEX

Production for Six Months, January Thru June



THE GLASS INDUSTRY'S INDEX

Foreign Trade for Six Months, January Through June



turers paid out almost $50,000,000 to their employees as compared to a little over $43,000,000 last year.

Foreign Trade: Exports of glass and glass products during June dropped 10 per cent below May's total to $1.053,000. This was 45 per cent greater than last June's figure, reflecting the continuance of our expanded export trade. Declines in sales of containers, tableware and miscellaneous glassware items accounted for the drop from May's high level; larger volumes in all lines were responsible for the gain over June 1939. An analysis of our export trade during the first half of 1940 reveals an increase of 41 per cent over last year to $6,075,000. On a percentage basis, window and plate glass made the greatest advances, while glass containers and tableware increased most in volume.

Imports of glass during June dropped to the lowest point in recent years with a reported volume of $185,000. (It is believed that a good portion of this represented withdrawals from ware houses rather than actual arrivals.) This June figure was 14 per cent below May and 57 per cent less than last year's comparable total. The decline from May was a reflection of the decreases reported in all lines with the exception of miscellaneous items; plate glass (with an increase of 100 per cent) was the only product that did not contribute to the drop from June of last year. During the first six months of 1940 our import trade was 45 per cent below last year's total. Here again plate glass ran counter to the trend, showing instead an increase of 248 per cent. Illuminating ware was off 85 per cent, window glass and containers 54 per cent, and table ware 28 per cent.

MONOPOLIZATION LEGAL IN CUBA

Cuba, by an article in its Constitution enacted July 5, 1940, has established a form of Patent Monopoly which is new, but which appears to be a reversion to the type of monopoly which caused enactment in England, in 1623, of the famous "Statute of Monopolies" which forms the basis of the patent system in this country as well as Great Britain. This is contained in Article 16, Section 4, of the new Cuban Constitution, which article should make interesting reading for members of the T.N.E.C. and those interested in the patent system in general.

The article provides that within two years from the date of promulgation of the Constitution, any natural or juridical person, on complying with certain conditions, can obtain a monopoly under the title of "Patent of Industrial Introduction" for any industry not previously existing in Cuba or existing only to the extent of supplying not more than 15 per cent of the Cuban consumption. This patent would endure for a period of 15 years but the patentee would be obligated to establish the new industry or enlarge the existing one within a period of 18 months from the date of the patent grant, or within the following year to provide for an outlet of at least 80 per cent of the national consumption.

During the life of the patent, no other person could manufacture or prepare, in Cuba, goods identical or similar to those covered by the patent of introduction, and to further protect the Patent Monopoly, it is provided that imports of articles covered by the patent will be subject to an additional 50 per cent ad valorem duty, providing that this is not contrary to any International Treaty.

UNITED STATES FOREIGN TRADE IN GLASS
(VALUE IN THOUSANDS OF DOLLARS)

	1940			*1939*		*Percentage Change*		
	June	*May*	*First six months*	*June*	*First six months*	*May-June*	*June-June*	*First six months*
EXPORTS								
Plate	145	132	702	45	407	+10	+222	+ 72
Window	35	24	121	4	19	+46	+775	+536
Containers	292	348	2155	259	1414	—16	+ 13	+ 52
Tableware	234	247	1178	167	856	— 5	+ 40	+ 38
Illuminating Ware	65	58	343	29	203	+12	+124	+ 69
All Other	282	360	1576	220	1409	—22	+ 28	+ 12
Total	1053	1169	6075	724	4308	—10	+ 45	+ 41
IMPORTS								
Plate	10	16	108	5	31	—37	+100	+248
Window	16	24	220	106	479	—33	— 85	— 54
Containers	14	16	89	16	193	—12	— 12	— 54
Tableware	24	41	310	81	431	—41	— 70	— 28
Illuminating Ware	6	8	40	22	261	—25	— 73	— 85
All Other	115	111	671	198	1218	+ 4	— 42	— 45
Total	185	216	1438	428	2613	—14	— 57	— 45

INVENTIONS AND INVENTORS

Summary of United States Patents of Interest to the Glass Industry Issued During June.

Furnaces

Hartford-Empire Company was assignee of the two June patents for glass tank operation and construction. Paul G. Willetts' patent 2,203,288 provides novel means of minimizing flux block wear at the metal line. Instead of carrying the molten glass surface several inches below the top of the flux block, he allows a thin film of glass to overflow the top of the block, and chills it by water cooling. It is stated that corrosion is then a glass-on-glass proposition which saves the refractory, as illustrated in Fig. 1.

The other Hartford-Empire furnace patent was Vergil Mulholland's 2,203,269 which represents an improvement over his recent patent 2,068,925. The invention applies to continuous glass-melting furnaces in which the bridge-wall with submerged throat is replaced by a weir built from the bottom of the tank. Glass moves slowly to the refining end of the furnace over the top of this dam. Construction and operation of the furnace is directed toward eliminating backward flow from the refining end which contaminates the glass.

Feeding, Forming and Shaping

Charles B. Garwood assigned to Carr-Lowrey Glass Co. his patent 2,205,382 for a means of producing bottles without the necessity of transferring a parison or blank from one mold to another. As shown in the three sketches in Fig. 2, a plunger forces its way into a gob of glass to partially shape the bottle, and is retracted while the bottle is simultaneously blown in such a manner as to utilize the end of the plunger to shape the bottom of the bottle.

A complete fully-automatic bottle-forming machine, particularly suited to narrow-neck bottles, was patented by Samuel E. Winder. This patent 2,205,261 (assigned one-half to Henry C. Daubenspeck of Columbus, Ohio) carries out the entire process with the bottle in inverted position. In this respect it differs from earlier Winder machines covered by patents 998,824, 1,072,553, and 1,491,369. The invention replaces a neck ring by a suction head for supporting the parison while it is being transferred to the finishing mold.

A severing apparatus is covered by patent 2,205,868 assigned by the late Frank L. O. Wadsworth to Ball Brothers Company. One object of the invention was to provide severing means which are adapted to accelerate the downward velocity of the severed charge, and to give it movement in the direction of mold travel. The patent covers details of the mechanism. This patent is related to several other Wadsworth patents including particularly 2,100,760.

A molding press for glass or other plastic materials, was covered by patent 2,204,151 granted to Howard H. Rodefer and Henry Vaupel of the Rodefer Glass Co., Bellaire, Ohio. This press utilizes a floating mold chamber to give the effect of two direction pressing when only a single plunger is moved.

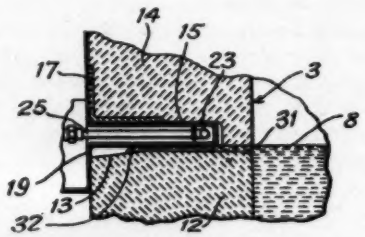
Patent 2,203,573 assigned by Paul Krause to Hudson Armstrong of Salem, N. J., provides a machine wherein a glass tube is divided and the ends closed adjacent to the division in order to provide vials, test tubes, etc. In a continuous operation, the glass tube is rotated over a burner to cause the division of the tube and the closure of the two halves.

Miscellaneous Processes

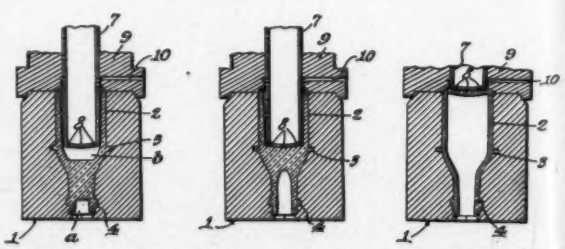
Two new patents provide means of sealing electrode leads into tubes and bulbs. One of these (2,205,582) was granted to Karl Steimel, Berlin-Steglitz, Germany who assigned it to Telefunken Gesellschaft fur Drahtlose Telegraphie m.b. H. Berlin. The practice of using a flame to soften glass for joining or for embedding metallic parts may damage the electrode system by combustion gases, particularly in small tubes. Steimel accomplishes the heating by an extremely high-frequency field, such as the ultra-short waves used in the radio communication art. The softened glass parts are pressed together.

The sealing-in machine elements patented by Frank J. Malloy of Cleveland Heights, Ohio, 2,203,917, were assigned to General Electric Company. The novel features apply to an apparatus for holding the work while the seal is being effectuated by flame, and subsequently by pressure. The process is said to be applicable to the larger type lamps, such as shown in the Wright patent 2,098,080.

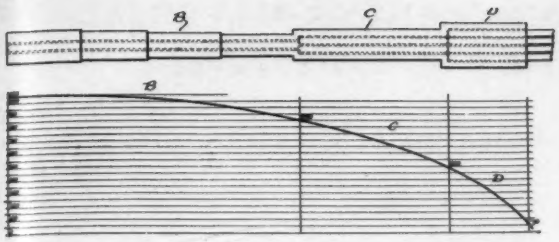
William W. Shaver of Corning, N. Y. received two patents on aspects of the novel Corning Glass processes for tempering glass articles. Patent 2,205,180 contains



2,203,288: Willetts. A thin layer of molten glass is allowed to flow over the top of the flux blocks. Here it is water cooled and serves to prevent the deep inroads into the refractory which occur when the metal line is carried at the lower level which is considered normal.



2,205,382: Garwood. In a one-step bottle-forming process, the plunger 7 forces a gob of glass around the walls of the mold, and is retracted while air is blown upward simultaneously; the bottom of the bottle is shaped against the end of the plunger.



2,203,182: Rendall. The temperature curve in a zoned lehr (heating zone not shown) is controlled to keep between the upper and lower annealing temperatures in zone B, and to give a desired rate of cooling in zones C and D. The number of rows of ware in each zone increases toward the cooling end.

a claim to "The method of case hardening glass ware which includes heating the glass in a molten bath and suddenly chilling the glass in a bath which will dissolve the constituents of the heating bath." For example, the bath for heating a glass article to 800 deg. C. might be composed of 2/3 sodium sulphate and 1/3 potassium chloride, and the quenching liquid held at 150 deg. C. might be 44 per cent sodium nitrate and 55 per cent potassium nitrate with small amounts of other agents. Traces of salt from the heating solution which cling to the glass are readily dissolved in this chilling bath. There is a certain range of suitable salts for both baths, fulfilling the detailed requirements with regard to specific gravity, stability, etc., which Mr. Shaver considers essential. Patent 2,205,181 is concerned with the same processes, but provides for the addition of certain acid oxides (silica, boric oxide, etc.) to the heating bath to prevent its attaining a degree of alkalinity which would attack the glass.

Jesse E. Figel of Indianapolis, Indiana (Fairmount Glass Works, Inc.) was granted one claim in his patent 2,203,385 for a lehr feeder adapted to receive a single row of bottles from a molding machine and to transfer them in multiple rows to the conveyor of an annealing lehr.

Details of the construction and operation of an annealing lehr were also patented by William S. Rendall of Baltimore (2,203,182, assigned to Crown Cork & Seal Co.). The primary purpose was to give the ware a controlled zonal treatment, as indicated in Fig. 3. Control means consist of shutters between the zones, different travel rates and other procedures including a spreading out of the bottles into a greater number of rows as the cooling zones are reached.

A banding or striping machine particularly adapted to ornamenting plates was patented by Robert H. Johnson of Morgantown, W. Va. This is 2,203,572. A series of plates, held in vertical position by vacuum controlled chucks, are automatically centered and brought into position at the color applicator stations.

Plate and Sheet Glass

Resin plastic sheets for safety glass compositions continue to constitute a field for research. Two new patents appeared in June in this field. Joseph D. Ryan of Libbey-Owens-Ford Glass Co., Toledo, in patent 2,205,020 covered the use of an aliphatic acid ester of diglycerol as a plasticizer for a vinyl acetate type of plastic sheet. For the same type of plastic sheet, Lucas P. Kyrides patented a neutral alkly ester of an acid selected from the group consisting of diglycollic acid and thiodiglycollic acid. This is patent 2,205,420, assigned to Monsanto Chemical Co., St. Louis.

Another Libbey-Owens-Ford patent is 2,205,003 granted to Emmett L. Walters for an apparatus for assembling safety glass by machine. This assembling has been mostly hand work. The apparatus is partially illustrated by the sketch in Fig. 4.

New Products and Uses

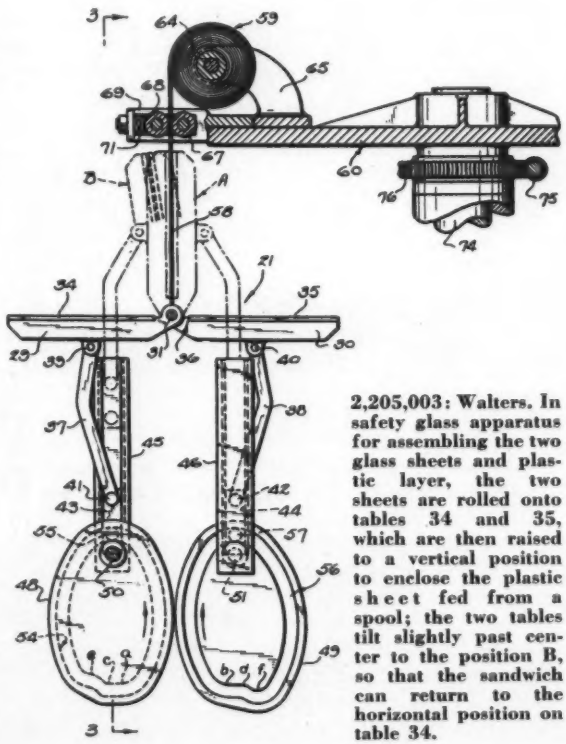
A highly flexible decorative coated glass fiber fabric is described in patent 2,204,859 assigned by Chas. S. Hyatt and John C. Lowman to the Columbus Coated Fabrics Corp., Columbus, Ohio. A fabric of glass fibers is etched, then coated with a composition, and dried.

A use of glass fibers in an electric commutator was described in patent 2,202,820, assigned to Owens-Corning Fiberglas Corp. by Fred J. Baird and Allen J. Simison of Newark, Ohio.

Patent 2,205,515 to Paul M. Burroway of Phoenix, Arizona, concerns a hollow glass building block adapted for use in house numbering.

The design of a solid glass stem for a beverage glass was patented by Andrew J. Cunningham, Eggertsville, N. Y., and Victor Walker, Fort Erie, Ontario. This is patent 2,203,647 assigned to Alfred H. Sharpe of Buffalo.

A composite cellular glass block was patented by Wm. O. Lytle of New Kensington, Pa., and assigned to the Pittsburgh Plate Glass Company. This is 2,205,534. A typical modification consists of a cellular glass block united to a decorative facing of non-porous glass by means of a synthetic resin.



2,205,003: Walters. In safety glass apparatus for assembling the two glass sheets and plastic layer, the two sheets are rolled onto tables 34 and 35, which are then raised to a vertical position to enclose the plastic sheet fed from a spool; the two tables tilt slightly past center to the position B, so that the sandwich can return to the horizontal position on table 34.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	46.00	43.00
Reduction on precipitated material, $5.00 a ton			
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)	lb.	....	....
Granulated	In bags, lb.	.0215	.027-.0295
Powdered	In bags, lb.	.024	.0295-.032
Boric acid (H_3BO_3) granulated	In bags, lb.	.048	.054-.0565
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.0865-.0875	.0925
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—(published list prices)			
20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	30.00-31.00	....
In bags	ton	31.60-32.60	42.00-45.00
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.075	....
In 5 Ton lots	lb.	....	.08
Less than 5 Tons	lb.	....	.085
Lime—			
Hydrated ($Ca(OH)_2$-MgO) (in paper sacks)	ton	8.50	8.50
Burnt (CaO-MgO) ground, in bulk	ton	7.00	....
Burnt, ground, in paper sacks	ton	9.00	9.00
Burnt, ground, in 180 lb. drums	Per drum	1.60	1.70
Kiln Dried ($CaCO_3$-$MgCO_3$) 10x30 mesh	ton	1.75	....
Kiln Dried ($CaCO_3$-$MgCO_3$) 16x120 mesh	ton	1.75	....
Nepheline Syenite, f. o. b. shipping point	ton	12.50	14.50
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.065	.0675
Hydrated 80-85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4)	ton	18.00-20.00	25.00
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb	.95	....
In barrels	Per 100 lb.	1.35	....
In bags	Per 100 lb.	1.10	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls	Per 100 lb.	....	2.50-2.90
95% and 97%			
Bulk	Per 100 lb.	1.35	....
200 lb. bags		1.415	1.44
100 lb. bags		1.45	1.475

Special Materials

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.026-.029	.03½
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Antimony oxide (Sb_2O_3)	lb.	.14	.14½
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03¼	.03¾
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)	ton	9.00	12.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.08¼	.08½-.09
Tin Oxide (SnO_2) in bbls	lb.	....	.55
Titanium Oxide (ceramic grade)			
In bags	lb.	.12	.12¼-.12¾
In barrels	lb.	.12¼	.12½-.13
Zinc Oxide (ZnO)			
American process, Bags	lb.	.06¼	.06½
White Seal, 150 lb. bbls	lb.	.08¾	.09
Green Seal bags	lb.	.08	.08¼
Domestic White Seal bags	lb.	.08½	.08¾
Red Seal, bags	lb.	.07½	.07¾
Zircon			
Refined Granular (Milled .01-.02c higher)		.06½	.07-.08

Coloring Materials

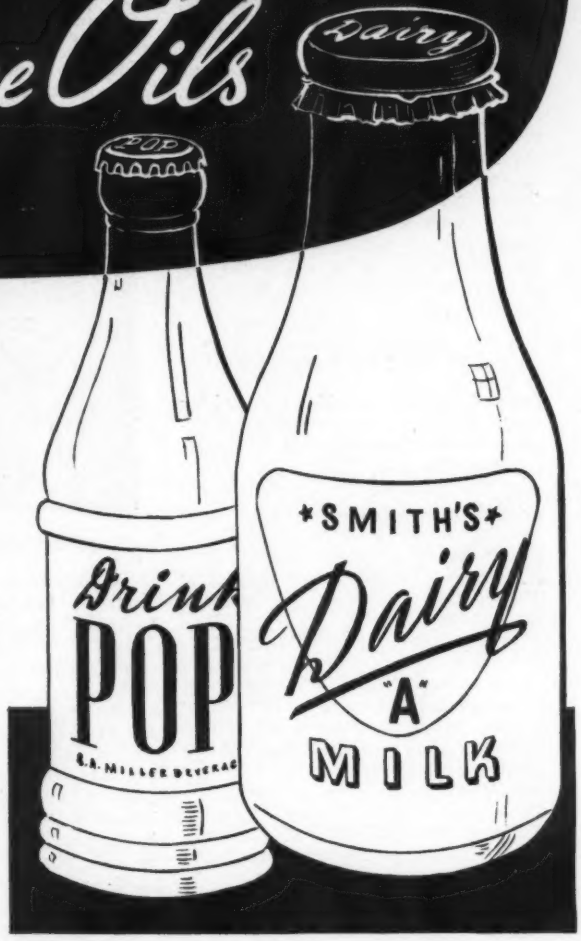
		Carlots	Less Carlot
Barium selenite ($BaSeO_3$)	lb.	....	1.40-1.60
(Commercial, 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	1.00-1.05
Cerium hydrate—			
100 lb. drums and 600 lb. barrels	lb.	....	.60
Chrome Oxide Green, 400 lb. bbls	lb.	....	.22-.25
Chromite (99% through 200 mesh)	ton	40.00	44.50
Chromite ore (air floated)	ton	55.00	58.00-73.00
Cobalt oxide (Co_3O_4)			
In bbls. 350 lbs. or more,	lb.	....	1.84
Less than 350 lbs.,	lb.	....	1.94
Copper oxide—			
Red (Cu_2O)	lb.	....	.165
Black (CuO)	lb.	....	.18-.19
Black prepared	lb.	....	.22
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.05-.05½
Black (Fe_3O_4)	lb.	.04½	.09
Iron Chromate	lb.	....	.035-.05
Lead Chromate ($PbCrO_4$) in bbls	lb.	....	.135
Manganese, Black Oxide			
In Paper bags	ton	62.50	70.50
In Burlap bags	ton	64.25	72.25
In Casks	ton	66.50	74.50
Neodymium oxalate, 50 lb. drums	lb.	....	3.50
Nickel oxide (Ni_2O_3), black	lb.	....	.35-.40
Nickel monoxide (NiO), green	lb.	....	.35-.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals and Granular	lb.	.08¾	.09-.09¼
Powdered	lb.	....	.09½-.09¾
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.19-.24
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) In 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¾	.07-.07¼
Sodium chromate (Na_2CrO_4) Anhydrous	lb.	.08½	.08½-.08½
Sodium selenite (Na_2SeO_3)	lb.	....	1.50-1.65
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.75-1.85
Yellow	lb.	....	1.75-1.85
Sulphur (S)—			
Flowers, in bbls	Per 100 lb.	3.35	3.70-4.10
Flowers, in bags	Per 100 lb.	3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls	Per 100 lb.	2.90	3.25-3.65
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	....	2.65-2.75
Yellow orange	lb.	....	1.75-1.85

Polishing Materials

		Carlots	Less Carlots
Emery, Turkish	lb.	.063	.07
Pumice Stone,			
American Ground Italian FFF, FF, F	lb.	....	open price
0, 0½, ½, 1.	lb.	....	open price
Putty Powder	lb.	Open price.	
Rotten Stone, (Domestic)	lb.	....	.03½
Rouge, Red	lb.	....	.16
Black	lb.	....	.18

"CERAMIC"

Alkali resisting Colors and Squeegee Oils



• **The strong alkali washing compounds used to clean food and drink containers demand the best in colors. Whether used for decoration or product identification, you will find "Ceramic" Alkali Resisting Colors the best available. They are developed in our laboratory, applied and test fired under factory conditions.**

Superior colors demand superior oils, and "Ceramic" Squeegee Oils are prepared especially for "Ceramic" Alkali Resisting Colors.

"Ceramic" Alkali Resisting Colors can be furnished either in the powder form or in the paste form ready for application. "Ceramic" Squeegee Oils are also available for various types of work including low fire, high fire, and overlapping work. Special oils are compounded for special jobs.

White enamels, weather resisting enamels, satin matt finish colors, high fire colors, fluxes, ices, decorating supplies and ceramic chemicals are also stock items.

"Ceramic" COLORS

CERAMIC COLOR & CHEMICAL MFG. CO.

NEW BRIGHTON, PA., U.S.A.

EQUIPMENT AND SUPPLIES

HYPRESSURE JENNY

The Hypressure Jenny, a portable self contained steam cleaning unit, has recently been put on the market by the Homestead Valve Manufacturing Co., Coraopolis, Pa., for use in factories and in the field where machinery is to be cleaned for inspection or repairs.

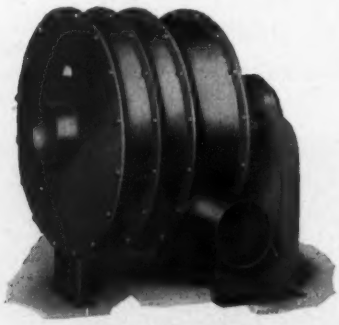
Operating pressures may be obtained in a few minutes, using fuel oil as a heating medium with electric spark ignition. The water tank surrounds the fuel tank, combustion chamber and stack, thus utilizing heat that would be wasted to preheat the fuel oil and water solution. The unit is fully automatic with constant high pressure and is controlled by the operator at the cleaning nozzle. All machinery is mounted on one end of the unit and is accessible by an easily removable cover.

For plants having high pressure steam available throughout, a fireless model Jenny operates on plant steam line pressures of 50 to 175 pounds direct, or on higher pressures through a reducing valve.

I-R MOTOR BLOWER

A new "Motorblower" ideally suited for furnishing air to oil- and gas-fired furnaces has been announced by the Ingersoll-Rand Company, 11 Broadway, New York. The unit can be installed on any floor since it requires no special foundation. A built-in blast gate is located in the blower discharge and flexible pipe connections are provided for connecting either intake of discharge to shop piping.

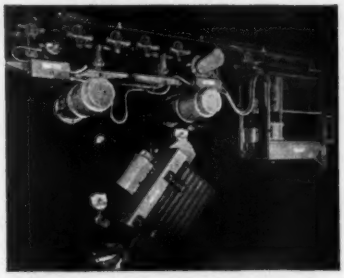
The maintenance of constant pressure over the entire volume range is stressed as being particularly advantageous in furnishing combustion air. The blower permits direct connection to several burners, and one or more of which can be turned off without affecting the operation of the rest. Type "G" Motorblowers are built in 72 sizes: pressures from ½ to 2¼ lbs. and volumes from 100 to 4500 cfm. are available. The discharge opening on all sizes can be located in any one of 8 positions in steps of 45 degrees.



Type "G" Motorblower

SULLIVAN UNITAIR

A new small stationary compressor has just been developed by the Sullivan Machinery Company, Michigan City, Ind., suitable for small industries and for standby service. Known as the WL-70, it is a two cylinder, single stage compressor with complete air cooling and features a built-in aftercooler; force feed lubrication; heavy duty ball main bearings; low lift, long life valves; air filter silencers on each cylinder; automatic regulation and easy accessibility for inspection. The compressor is built in five sizes: 96 to 233 c.f.m. displacement, 15 to 30 H.P., air pressures 30 to 125 lbs. The Unitairs are supplied as complete motor driven units on a rigid steel sub-base, direct connected or V-belt drive. They may be supplied less sub-base with V-belt sheave or flat belt pulley.



TRAMRAIL CARRIER

It is reported that the Cleveland Tramrail Division of the Cleveland Crane and Engineering Company, Wickliffe, Ohio, has just developed a new tilting box grab and Tramrail carrier that picks boxes up, sets them down, or empties them by tilting. All operations are manipulated by means of controller in the cab. The equipment consists of a cab-operated Cleveland Tramrail motor-driven carrier with two independent hoisting units and motorized grab. The hoisting units make it possible to raise or lower boxes as desired and empty them as fast or as slowly as may be required.

The boxes used with the grab are provided with four suspension brackets, two on each side as seen in the illustration. Motor-driven sliding latch bars in the grab may be extended into or retracted from the suspension brackets by the operator in the cab. In operation the grab is passed between the suspension brackets and stopped at proper position by means of heel of grab which is brought against end of box. Boxes can be picked up or spotted in place easily and quickly by the operator at distances of 30 to 40 feet below the carrier. The suspension brackets make it possible to interlock the boxes and facilitates stacking in even tiers.

Sullivan Unitair compressor

CATALOGS RECEIVED

Stephens-Adamson Mfg. Co., Aurora, Ill. Bulletin 240. A new S-A folder describing their line of Box Car Loaders and Pilers; used for loading box cars and piling of most loose bulk materials.

Cambridge Instrument Co., New York. Folder 910E describes the portable Cambridge Electron-Ray pH Meter which is sensitive to .005 pH. It incorporates an Electron-Ray tube in place of the conventional null-point indicator. The dial is scaled in pH and Millvolts. Folder 910T describes the Cambridge Thermionic pH Recorder with which pH values can be continuously recorded under plant operating conditions.

General Refractories Co., Philadelphia. Bulletin 209, in which their general line of Sillimanite refractories is described. The bulletin covers brick, cement and plastic sillimanite.

The American Foundry Equipment Co., Mishawaka, Ind. Circular 32, which describes the new American High Efficiency Cyclone Dust Collector. It is of the high efficiency, long cone cyclone type and high efficiencies are obtained with relatively low back pressure.

Pyrometer Instrument Co., New York. Catalog 108, illustrating a number of heat measuring instruments in both portable and stationary lines.

The Korfund Co., Long Island City. Bulletin Ba-14. A bulletin on the Korfund Vibration Control for machinery mountings on concrete foundations.

The Northern Blower Co., Cleveland. A folder on the "Norblo" line of dust recovery and dust removing systems, ranging in size from portable to stationary units.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

CAREFUL WITH YOUR SPEECH— IT WILL GET IN THE DICTIONARY

At long last, the quaint and elusive phraseology of the glasshouse has crashed the dictionary, and has become officially admitted to the English language. The newest edition of Webster's unabridged contains between 200 and 300 definitions of glass terms: such as "gaffer," "low tank," etc. Also words that in themselves seem to have no connection with the glass industry, such as "gatherer," have been defined as they relate to glass.

When the publishers of the dictionary, most conservative of institutions, became aware that this indeed was the Glass Age, they needed someone competent to supply and properly define this vocabulary. So they wrote to Corning. Ellsworth B. Gore received the assignment. It is reported that Mr. Gore devoted 300 hours to the task. Although Corning Efficiency is a matter of common knowledge, we are lost in admiration of the evident completeness of the time keeping system.

HEAT TRANSFER MEASUREMENTS

A paper of interest to glassmen was presented at the thirty-second semi-annual meeting of the American Institute of Chemical Engineers at Buffalo, May 13, by Alan S. Foust, Dept. of Chemical Enginering, University of Michigan, and T. J. Thompson, Industrial Division, Corning Glass Works, titled "Heat Transfer Coefficients in Glass Exchangers." A summary of the paper is as follows.[1]

This paper presents results of heat transfer measurements in double-pipe exchangers, the inner pipes being of Pyrex glass, 1″ and 2″ in diameter. The results indicate that non-boiling coefficients may be computed from the Dittus-Boelter equation, using an increased numerical coefficient for calculation of the annulus film. Measurements for condensing steam indicate that the resistance of the steam film is very small compared to the water film, even though the amount of condensate accumulating is quite large.

Coefficients for dehumidification of wet air are presented as a nomograph covering air velocities from 13 to 135 ft. per sec., and moisture contents from 10 to 60 per cent, both at entering conditions. Cooling water was used at temperatures from 50 to 95°F. entering, and rates from 0.3 to 3.3 ft. per sec. The mass transfer rates corresponding to these coefficients correlate consistently 25 per rent below the results of Colburn and Hougen for a vertical tube, which was much shorter than the four pass exchangers used in this investigation. In a surprising number of conditions, the condensing film coefficients are high enough that the water film offers the dominant resistance.

Evidence indicating that the thermal conductivity of Pyrex is higher than published values is discussed.

This was calulated by two different methods:

1. the thermal conductivity is, 1.00 btu/hr./ft./°F. at an average temperature of approximately 100°F.
2. 0.85 btu/hr./ft./°F.

The authors conclude that the conductivity of Pyrex glass ware is higher than published values perhaps as much as 25 per cent.

[1]This complete paper will be published in the Transactions of the American Institute of Chemical Engineers, August 25, Vol. 36, No. 4.

G.C.A. AMBULANCE

In the article about the G.C.A. ambulance which appeared in the July issue of THE GLASS INDUSTRY, we neglected to give proper credit to the guiding spirit and inspiration of its sponsor, Dr. Frank W. Preston of Butler, Pennsylvania. Full credit should be given to Dr. Preston for his part in this drive and the time and energy spent to make it a success.

Below is a list of contributors who made the ambulance possible, and not just an idea.

Ball Brothers Company, Muncie, Ind.
Per Mr. M. D. Lincoln
Brockway Glass Company, Inc., Brockway, Pa.
Buck Glass Company, Baltimore, Md.
Per Mr. R. A. Blunt
Carr Lowrey Glass Company, Baltimore, Md.
Per Mr. C. G. Hilgenberg
Per Mr. G. F. Lang
B. F. Drakenfeld & Company, Washington, Pa.
Foster-Forbes Glass Company, Marion, Ind.
Per Mr. J. M. Foster
Glass Container Association, New York City
Per Mr. E. G. Ackerman
Glenshaw Glass Company, Glenshaw, Pa.
Hazel-Atlas Glass Company
Per Mr. F. C. Flint, Washington, Pa.
Per Mr. J. H. McNash, Wheeling, W. Va.
Per Mr. W. H. McClure, Wheeling, W. Va.
Per Mr. J. S. Algeo, Wheeling, W. Va.
Knox Glass Associates, Oil City, Pa.
Per Mr. R. R. Underwood, Oil City, Pa.
Per Mr. C. R. Underwood, Jackson, Miss.
Latchford-Marble Glass Company, Los Angeles, Cal.
Per Mr. John M. Marble
Per Mr. O. S. Parker
Lummis Glass Company, New York City
Per Mr. L. A. Lummis
Lynch Corporation, Anderson, Ind., per Mr. A. G. Doll
Maryland Glass Corporation, Baltimore, Md.
Per Mr. J. S. Heuisler
Ogden-Watney Publishers, New York City
Per Mr. J. T. Ogden
Owens-Illinois Glass Company, Toledo, Ohio
Per Mr. W. E. Levis
Preston Laboratories, Butler, Pa.
Tygart Valley Glass Company, Washington, Pa.
Per Mr. O. C. Noble

O-I ANNOUNCES PROMOTION

Mr. Paul Muller, branch manager of the New York office of the Owens-Illinois Glass Company, has been promoted to the position of Eastern Sales Manager of the Glass Container Division. Mr. Muller succeeds Edward F. Glacken, who as president of Owens-Illinois Distributors, Inc., will devote all his time to the distribution of the company's ware in the dairy field. In his new position, Mr. Muller will have charge of five eastern branches of O-I, and will continue his headquarters in New York.

Mr. Clark Rodgers, assistant branch manager of the New York office, has been promoted to the branch managership to succeed Mr. Muller. Mr. Rodgers was formerly located at various branches in the Middle West before coming to the New York office.

KYANITE

the modern source of alumina for

GLASS

PAINSTAKING RESEARCH and laboratory development has resulted in the issuance of a patent for a glass composition containing Kyanite as a source of alumina. Methods of preparation insuring purity and uniform grain size have received careful consideration.

Since the granting of this patent Celo Mines, Inc., has been developing facilities for the processing of this new glass batch material and is now in a position to offer to the glass manufacturing industry this highly efficient source of alumina.

Glass manufacturers whose products must be of low alkali content will find Kyanite competitively priced and of constant highest alumina content. Modern processing methods and equipment insure uniform quality and dependable service and delivery.

For complete technical information and other data address your inquiry to—

CELO MINES, Inc.

BURNSVILLE • NORTH CAROLINA

A. C. S. SUMMER MEETING

The Glass Division of the American Ceramic Society will meet September 6 and 7 at the Hotel Hershey, Hershey, Pennsylvania. A tentative schedule is being arranged to have two technical sessions, one Friday afternoon, Sept. 6, and one Saturday morning, Sept. 7. The subjects to be discussed will be chemical durability, homogeneity of glass and chemical analysis. At least two papers will be given on durability, two papers on homogeneity of glass and one paper on analysis. The authors and paper titles are tentative as yet.

In the lighter vein, there will be golf on Saturday afternoon and in the evening an informal banquet will be held. Trips have been arranged for the Hershey Industrial School, Hershey Plant, and the Model Town of Hershey.

MAURICE A. SMITH

Maurice Alexander Smith, president of the McKee Glass Company, Jeannette, Pennsylvania, died July 22, at the Magee Hospital, Pittsburgh.

A native of Fostoria, Ohio, Mr. Smith was a graduate of the Mercersburg Academy and Cornell University. In 1911, he became associated with the McKee Glass Company and in 1924 was named president. He was a member of the board of directors of several concerns, a member of the Jeannette Chamber of Commerce, the American Ceramic Society and the Society of Automotive Engineers. Mr. Smith was the author of numerous papers on the glassware industry.

LEADING MANUFACTURERS OF GLASS

Rely on our Felts

American Polishing Felts give superior service and have longer, satisfactory life. Polishing costs less and goes along without hitches when American Quality Felt is used, because it has uniform density and increased absorption properties. Greater strength against strains and stresses of mounting felt on the polishing heads is another reason. Then, too, our Felt is put through a conditioning process which makes it ideal for beginning of the line and effects long life so that it performs satisfactorily at the important end of the line polishing. You are cordially invited to discuss any problem regarding polishing or the use of Felt with our Technical and Research Staffs.

American Felt Company

TRADE MARK

General Offices: 315 FOURTH AVE., NEW YORK, N. Y.

Plants at Glenville, Conn., Newburgh, N. Y., Franklin, Mass., and Detroit, Mich.

"A Felt for Every Purpose . . . A Standard for Every Felt"

COMBUSTION CALCULATIONS

(*Continued from page* 359)

The heat loss could be computed by converting the above volume of gases to pounds and multiplying each by its mean specific heat.

In this case, however, the heat content per pound mol is taken from the temperature heat content curves included in the text. The volumes in cubic feet are divided by the factor 359, to reduce them to pound mols. With a stack temperature of 900° F. at the damper the heat loss is as follows:

Product	*cu ft. per hr. in flue gas*	*Mols per hr*	*B.T.U. per Mol at 900° F*	*B.T.U. per hr. carried to atmosphere*
O_2	16,650	46	61,000	280,600
CO_2	61,016	142	89,500	1,270,900
N_2	477,334	1,326	61,000	8,088,600
H_2O (vapor)	116,150	323	75,500	2,438,650
Heat loss per hour				11,878,750 B.T.U.

[1] Volume of 1 lb. mol. at 32° F. and 29.92 "Hg. pr. = 359 cu. ft.
[2] Haslam and Russel. "Fuels and Their Combustion."

AMERICAN CHEMICAL SOCIETY

The 100th national meeting of the American Chemical Society will be held in Detroit, September 9 to 13. It is expected that more than 4,000 chemists, industrialists, educators, and representatives of the allied trades will participate in the sessions, at which the role of chemistry in national defense will be discussed. Petroleum, rubber and food will be outstanding themes. All the Society's eighteen professional Divisions will convene. Several hundred papers and addresses dealing with practically every major field of chemical science and industry will be represented.

A session on "Glass—What is Old? What is New?" under the chairmanship of Dr. Alexander Silverman is announced by the Division of Industsrial and Engineering Chemistry. A symposium on "New Textile Fibers, Fabrics and Finishes," with Dr. Gustavus J. Esselen as chairman, will also be in this division.

William Pitt Putnam, president and founder of the Detroit Testing Laboratories, has been named general chairman, with Harvey M. Merker, superintendent of manufacturing of Parke, Davis and Company, as co-chairman. Charles F. Kettering, vice president of General Motors, has been appointed honorary chairman.

PYRO THE SIMPLIFIED OPTICAL PYROMETER

THE ONLY SELF-CONTAINED, DIRECT READING OPTICAL FOR GLASS AND CERAMIC PLANTS

The waste and spoilage that result from guesswork concerning temperatures represent dollars that might just as well have been thrown in the furnace. PYRO takes all the guesswork out of temperature reading; it is a *LIGHT WEIGHT* (3 *lbs.*) *SELF-CONTAINED, DIRECT READING, sturdy unit* made to stand rough use but it is absolutely *ACCURATE* and *DEPENDABLE.*

Unique construction enables operator to rapidly determine temperature even on minute spots, fast moving objects or the smallest streams.

Stock Ranges 1400-5500° *F.*

Write for our new Catalog No. 80

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★ *High Quality*
★ *Iron Free*
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SODIUM SULPHATE

·SALT CAKE·SALT

★ ★ *Commercial samples are available from our new plant at Dale Lake, California*

DESERT CHEMICAL CO.
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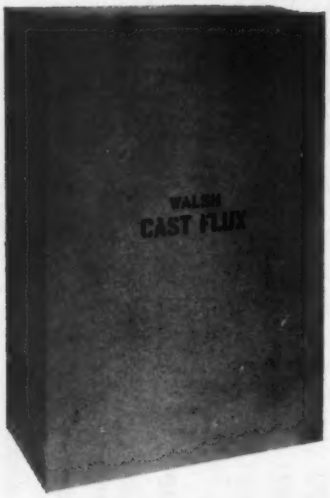
THE OTTAWA SILICA COMPANY
OTTAWA. ILLINOIS

THREE PLANTS TO SERVE YOU
OPERATING YEAR AROUND

WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

Walsh Cast-Flux blocks are machine-trued to exact size and shape after burning.

THEY LAST LONGER

The excellent results obtained in numerous tanks melting various types of glass has definitely established the efficiency and economy of Walsh Cast-Flux blocks.

Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

WALSH REFRACTORIES CORPORATION

Manufacturers of Refractories for the glass industry for over 50 years

4428 North First Street
St. Louis Missouri

C-14 MEETS IN ATLANTIC CITY

The A.S.T.M. Committee C-14 on Glass and Glass Products met in Atlantic City June 25 and 26 for the purpose of hearing reports of the several sub-committees and to elect officers for the coming year.

Sub-committee I on Nomenclature and Definitions, F. C. Flint, chairman, did not report, but there was discussion from the floor regarding the usage of the word "glass" especially in connection with the organic "glass" wearing apparell. Due to the absence of Dr. Lundell, chairman of Sub-Committee II on Chemical Analysis, there was no formal report from this committee. After a discussion of the work of this sub-committee by some of its members, it was decided to request Dr. Lundell to write up the data obtained from the cooperative work on the chemical analysis of the standard glass sample No. 128 for presentation at the fall meeting of the Glass Division of the American Ceramic Society. Mr. Donald Sharp, chairman of Sub-committee III on Chemical Properties, presented his report to the group in the form of a 45 page book which covered the entire two years work on the subject of chemical durability of glass. Mr. Sharp made recommendations for future work on this subject. In Sub-committee IV on Physical and Mechanical Properties, J. T. Littleton, chairman; Messr's Wadman and Sharp presented a proposed revision of the tentative methods dealing with polarscopic examination, pressure testing and thermal shock testing. The revision dealt largely with the method of sampling the bottles for test. This revision was approved by the committee. "The Tentative Methods of Measuring the Modulus of Rupture of the Glass Test Pieces" which was developed as the result of work by Sub-committee IV was also considered and accepted. This method will be voted upon by letter ballot before final acceptance. Mr. Rapp reporting for Mr. J. P. Staples, chairman of Sub-committee VI on Glass Construction Block and Tile, briefly described the fundamental work being pursued by the manufacturers. There was no formal report from Sub-committee V on Thermal Properties.

At the business meeting the following officers were elected: G. W. Morey, chairman; U. E. Bowes, vice chairman; and L. Navias, secretary. The Advisory Committee is composed of the following men; J. C. Hostetter, G. F. Jenko, J. T. Littleton and R. W. Wampler.

ALTEN'S *Heat-Treated*
PLUNGERS

DENSE STRUCTURE
READY MACHINABILITY
LONGER WEAR

ALTEN'S
Foundry and Machine Works
LANCASTER OHIO

FORTER-TEICHMANN CO.

Engineers and Contractors

for

The Glass Industries

E-X-C-L-U-S-I-V-E-L-Y

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119 Federal Street, Pittsburgh, Pa.

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For Highest Lustre use GUNITE blanks and moulds

• As in all Gunite moulds and mould parts the milk blank casting of Gunite C-CA offers maximum service before removing for polishing. Highest lustre for glassware is obtained with Gunite blanks and blow moulds in automatic machine production.

There are four standard grades of Gunite available to meet varying conditions . . . Gunite A, A-C, A-CA and A-CCA.

Write for new price list and complete details.

GUNITE FOUNDRIES CORPORATION
Rockford, Illinois
Established 1854

Hit or miss methods of selecting soda ash, caustic potash and other alkalies you require for glass making have gone out of date.

Today, there are five important requirements to be considered when you place your order for an alkali . . .

QUALITY—Solvay Alkali quality is assured. The oldest and largest alkali producer . . . Solvay has established the quality standards of alkalies for years.

FORM OF PRODUCT—Many Solvay Alkalies are produced in various forms to meet your specific requirements.

UNIFORMITY—No hit or miss methods here—Solvay Alkalies are always as specified!

DISTRIBUTION—Three huge Solvay Plants in important industrial centers and many stock points assure efficient and on-time deliveries.

SERVICE—Do you have problems in alkalies? Solvay Technical and Engineering Service Division is maintained to help you.

SOLVAY DUSTLESS DENSE SODA ASH
More than 99.50% Sodium Carbonate *(on a dry basis.)*

SOLVAY DUSTLESS CALCINED 98-100% POTASSIUM CARBONATE
Also Granular Hydrated 84-85%

SOLVAY GROUND CAUSTIC POTASH

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Alkalies and Chemical Products Manufactured by The Solvay Process Company
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New Orleans . New York . Philadelphia . Pittsburgh . St. Louis . Syracuse

COLORS that *Sell!*

• Colors from HOMMEL give extra attractiveness to your products —lend an unusual richness that SELLS. Hundreds of satisfied customers use eye appealing HOMMEL shades for finest results.

Transparent and Opaque—Enamels and Fluxes—Liquid Lustre Colors—Acid and Alkali Resistant—Ices—Squeegee Colors—Burnish Gold and Silver.

Complete line of Glassmakers Chemicals including Barium Carbonate—Borax—Cadmium Sulphide—Feldspar—Fluorspar—Manganese Dioxide—Potassium Bichromate—Soda Ash—Sodium Nitrate—Uranium Oxide.

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Laclede Christy

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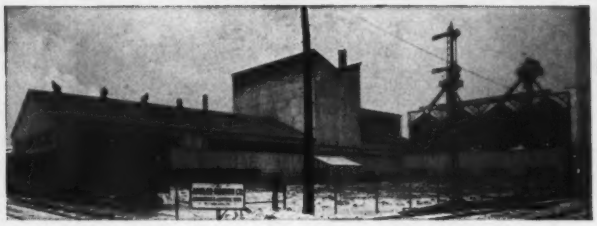
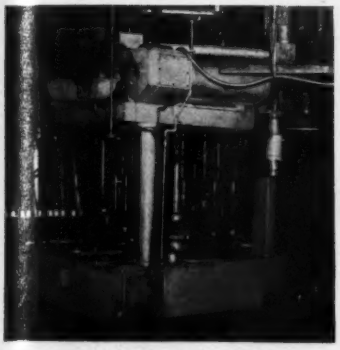
Our files contain the records of 3,380 tests on clays and minerals. We designed and built the first and largest test furnace exclusively for testing glass house refractories. We have maintained a Mellon Institute Fellowship for 20 years . . . all for the benefit of Glass Manufacturers.

V-6R1

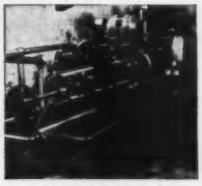


AMCO modern glass factories and modern equipment



High Speed Presses

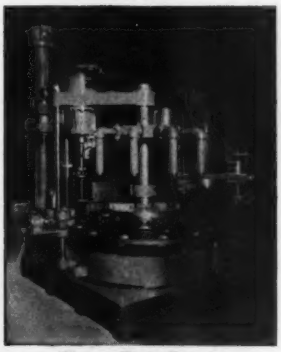
Grinding and Polishing Equipment



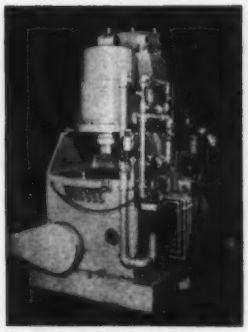
Tube-Drawing Machines

Rolled Sheet Glass Machines

Sheet Glass Lehrs



Heavy Duty Presses



High Speed Tumbler Presses

Fourcault Machines

Container Lehrs

Batch Mixing and Storage

Gas Producers—Coal Handling Machinery

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Transparent Colored Blown Sheet Glass
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Heat-Ray Resisting (Cool Glass)
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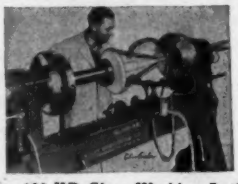
Chicago Office: 1597 Merchandise Mart
"IF IT'S MADE OF GLASS, ASK US FIRST"



No. 103-XB Glass Working Lathe

No. 57-X Laboratory Unit

SPECIAL GLASSWORKING MACHINES

Machines for the production of Incandescent lamps, Radio tubes, Television tubes, Glass Ampules and Vials, etc. Also a complete line of Glass Cutters for round and plate glass, Vacuum pumps, Tipping and blow torches, Cross fires and burners of all kinds.

EISLER ENGINEERING CO.
Chas. Eisler, Pres.
742 SO. 13 ST. (near Avon Ave.), NEWARK, NEW JERSEY

DESIGNS
MODELS
MOULDS
MOULD CASTINGS
Quality and Quick Service
....350 EMPLOYEES
OVERMYER
MOULD COMPANY
WINCHESTER, IND.

Who finds it pays?

These are some of the 845 companies that sent representatives to the national N. I. A. A. Conference last year . . . to take part in group discussions of marketing problems . . . present case studies . . . and study the advertising methods of industrial leaders.

You are invited to the 18th annual Conference of industrial sales promotion and advertising executives in Detroit next September . . . to get new ideas and information that will make your 1941 program more effective, more profitable. Write now for details.

Acme Steel Co.
Ajax Flexible Coupling Co.
Allis-Chalmers Mfg. Co.
American Can Co.
American Chain & Cable Co.
American Gas Furnace Co.
American Laundry Mach. Co.
American Locomotive Co.
Anaconda Copper Mining Co.
Anchor Post & Fence Co.
Appleton Electric Co.
Armstrong Machine Works
Atlas Lumnite Cement Co.
Atlas Powder Co.
Bakelite Corp.
Baldwin Belting & Leather Co.
Baldwin-Duckworth Div.
Baldwin-Southwark Corp.
W. F. & John Barnes Co.
Bathlehem Steel Co.
Black & Decker Mfg. Co.
Blaw-Knox Co.
Brown & Sharpe Mfg. Co.
Bucyrus Erie Co.
Bullard Co.
Butler Mfg. Co.
Byers Machine Co.
Calco Chemical Co.
Canadian Ingersoll-Rand Co.
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Carter Carburetor Co.
Celluloid Corp.
Century Electric Co.
A. B. Chance Co.
Chicago Bridge & Iron Co.
Chicago Molded Products Co.
Cincinnati Bickford Tool Co.
Cincinnati Milling Machine Co.
Cincinnati Shaper Co.
Clark Controller Co.
Cling Surface Co.
Colgate-Palmolive-Peet Co.
A. M. Collins Mfg. Co.
Columbia Alkali Corp.
Combustion Engineering Co.
Continental-Diamond Fibre Co.
Copperweld Steel Co.
Cornell-Dubilier Elec. Corp.
Crown Cork & Seal Co.
Cuno Engineering Corp.
Cutler-Hammer Inc.
Detroit Rex Products Co.
Dieki Mfg. Co.
Ditzler Color Co.
Dodge Mfg. Corp.
Dole Valve Co.
Domestic Engineering Co.
Duff-Norton Mfg. Co.
DuPont Co.
Durez Plastics & Chemicals
Thomas A. Edison Co.
Ex-Cell-O Corp.
Fafnir Bearing Co.
Fairbanks Morse & Co.
Farrel-Birmingham Co., Inc.
Ferranti Electric, Ltd.
Flintkote Co.
Foote-Burt Co.
J. B. Ford Sales Co.
Foster-Wheeler Corp.
Foxboro Co.
Frick Co.
Frontier Roller Bearing Co.
Fulton Syphon Co.
General Electric Co.
General Railway Signal Co.
Gisholt Machine Co.
Globe Steel Tubes Co.
B. F. Goodrich Co.
Gould Pumps, Inc.
Graver Tank & Mfg. Co.
Graybar Electric Co.
A. P. Green Fire Brick Co.
Guardian Electric Mfg. Co.
Hamilton Mfg. Co.
Hays Corp.
Heald Machine Co.
Hercules Powder Co.
Hevi Duty Electric Co.
Hilo Varnish Corp.
Hinde & Dauch Paper Co.
Hotstream Heater Co.
Hyatt Bearings Div.
Hygrade Sylvania Corp.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.
Insley Mfg. Corp.
International Nickel Co.
Irvington Varnish & Res. Co.
Johnston & Johnston, Inc.
Johns-Manville Co.
Joy Mfg. Co.
Keasby & Mattison Co.
Keohring Co.
Lamson & Sessions Co.
Landis Tool Co.
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Lignum-Vitae Products Corp.
Lindberg Engineering Co.
Link-Belt Co.
Locke Insulator Co.
Magnus Chemical Co.
Manhattan Rubber Mfg. Div.
Mason-Neilan Regulator Co.
Matthewson Alkali Works
Mattison Machine Works
Milcor Steel Co.
Mono Service Co.
Monsanto Chemical Co.
Morganite Brush Co.
Morse Chain Co.
National Automatic Tool Co.
National Carbon Co., Inc.
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Nation Vulcanized Fibre Co.
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New England Coke Co.
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N. Y. Belting & Packing Co.
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Osburn Mfg. Co.
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Owens-Corning Fiberglas Corp.
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Pennsylvania Salt Mfg. Co.
Permutit Co.
Philadelphia Quartz Co.
Pittsburgh Equitable Meter Co.
Pittsburgh Reflector Co.
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Republic Flow Meters Co.
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Rotor Tool Co.
Joseph T. Ryerson & Son, Inc.
S K F Industries, Inc.
Sangamo Electric Co.
Scott Paper Co.
Shepard Mills Crane & Hoist
Simons Saw & Steel Co.
Sloan Valve Co.
W. W. Sly Mfg. Co.
Stanley Works
Superheater Co.
Surface Combustion Corp.
Taylor Instrument Co.
Thermoid Co.
Thew Shovel Co.
Timken-Detroit Axle Co.
Timken Roller Bearing Co.
Truscon Steel Co.
Union Carbide Co.
Union Steel Products Co.
Unitcast Corp.
U. S. Pipe & Foundry Co.
U. S. Rubber Co.
U. S. Steel Corp.
Edward Valve & Mfg. Co.
Vickers, Inc.
Edward W. Voss Machinery Co.
Wagner Electric Corp.
Walton Truck Co.
Warner & Swasey Co.
Waukesha Meter Co.
West Disinfecting Co.
West. Elec. Instrument Corp.
West Penn Power Co.
Western Precipitation Corp.
Westinghouse Elec. & Mfg. Co.
Weyerhaeuser Sales Co.
Wheeler Reflector Co.
Wickwire Spencer Steel Co.
Edwin L. Wiegand Co.
Wilson Mechanical Instr. Co.
Wiremold Co.
Wolverine Tube Co.
York Ice Machinery Corp.

18TH ANNUAL CONFERENCE and EXPOSITION

NATIONAL INDUSTRIAL ADVERTISERS ASSOCIATION
Sept. 14-19, '40 DETROIT Hotel Statler

ISCO CHEMICALS

ISCO
CARBONATE
OF POTASH

Dustless Calcined 98/100%
Hydrated 83/85%

ISCO
CAUSTIC POTASH

Granular 90/92%

Special Glassmakers Grades made at our Isco Division, Niagara Falls, N. Y.

INNIS, SPEIDEN & CO.
117 Liberty Street New York, N. Y.
Branches: Chicago, Cleveland, Boston, Philadelphia, Gloversville, N. Y.
Factories: Jersey City, N. J.
Niagara Falls, N. Y.

GLASS INSPECTION
with the *Polaroid*

Spectacle type polariscope

THE polarizing spectacle, mounted in unit with sensitive tint plate of 565 millimicrons, presents an absolutely uniform field of large aperture, strains showing up in sharply defined and correct colors.

Standard size apertures are 6" diameter and 12" diameter; but any special size to meet your requirement can be made. They are all light in weight and a leather case can be furnished where required. The 6" unit is suggested for either plant inspection uses or—as a portable unit for the trouble shooter or the salesman where a large aperture, compact unit of light weight is desirable.

THE POLARIZING INSTRUMENT CO.
630 Fifth Ave. (Rockefeller Center) **New York City**

CLEVELAND TRAMRAIL HELPS MAKE
SUPERIOR QUALITY MILK BOTTLES
at THATCHER MANUFACTURING CO.

Cleveland Tramrail cab-operated tractor unit pushing a train of five loaded batch buckets into position at electrical pusher of No. 3 furnace. The batch is unloaded into the doghouse by the teaser who operates the pusher by means of control on furnace-floor level.

For the highest quality milk-bottle glass, the ingredients must be held to exact proportions at all times.

To assure no variation in the mix, the progressive Thatcher Manufacturing Company installed a Cleveland Tramrail batch-handling system. This eliminates segregation difficulties and assures uniformity day in and day out.

Thatcher milk bottles are consistently alike. The great strength and pertinent features of any one bottle will be found in every other bottle. As a result, Thatcher customers get bottles that are always up to specifications.

Cleveland Tramrail equipment has been developed for many plants for handling batch materials to furnaces requiring from 60 tons to 1200 tons in a 24-hour period. Automatic, semi-automatic, and simple hand-propelled systems are in use.

If you are interested in securing higher quality, consistently uniform glass, we invite your inquiry.

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
1161 Depot Street Wickliffe, Ohio

CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT
Other products: CLEVELAND CRANES and STEELWELD MACHINERY